NPS67-80-02CR

NAVAL POSTGRADUATE SCHOOL

Monterey, California

CONTRACTOR REPORT

TRANSONIC COMPRESSOR: PROGRAM SYSTEM TXCO FOR DATA ACQUISITION AND ON-LINE REDUCTION

H. ZEBNER
BDM CORPORATION
P.O. Box 2019
Monterey, CA 93940

October 1980

Interim Report for Period
October 1979 - September 1980

Approved for public release; distribution unlimited

Prepared for:
Naval Postgraduate School
Monterey, California 93940

FedDocs
D 208.14/2
NPS-67-80-02CR

DUDLEY KNOX LIBRARY
NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA 93943

NAVAL POSTGRADUATE SCHOOL

Monterey, California

Rear Admiral J. J. Ekelund
Superintendent

D. A. Schrady
Acting Provost

The work reported herein was carried out for the Naval Postgraduate School by the BDM Corporation under Work Order 426, under Contract Number N00014-78-C-0204. The work contributed to the program entitled Transonic Compressor Investigations funded in part by Work Request N00019-80-WR-01199 and under the cognizance of Dr. H. J. Mueller, and to the program entitled Axial Compressor Flow Fields funded in part by Work Request N00014-79-WR-90048 and under the cognizance of Mr. J. R. Patton, Jr.

The author is a candidate for the degree D. Ing under Prof. H. Gallus at Rhein.-Westf. Techn. Hochschule, 51 Aachen, W. Germany.

This report was prepared by:

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: NPS67-80-02CR	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): TRANSONIC COMPRESSOR: PROGRAM SYSTEM TXCO FOR DATA ACQUISITION AND ON-LINE REDUCTION	5. TYPE OF REPORT & PERIOD COVERED: Contractor Report, October 1979 - September 1980
	6. PERFORMING ORG. REPORT NUMBER: XXXXX
7. AUTHOR(s): H. Zebner	8. CONTRACT OR GRANT NUMBER(s): N00014-78-C-0204
9. PERFORMING ORGANIZATION NAME AND ADDRESS: BDM Corporation, P.O. Box 2019, Monterey, CA 93940	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: Work Order 426
11. CONTROLLING OFFICE NAME AND ADDRESS: Naval Postgraduate School, Monterey, CA 93940	12. REPORT DATE: October 1980
	13. NUMBER OF PAGES: 279
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report): Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public Release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Interim Report: Principal Investigator, Dr. R. P. Shreeve, Director Turbopropulsion Laboratory, Naval Postgraduate School, Monterey, California 93940

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Data Acquisition Program

Transonic Compressor

Compressor Test

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A system of data acquisition and reduction programs, TXCO is described. The programs were written for the transonic compressor test facility at the NPS Turbopropulsion Laboratory which is served by an HP1000 series computer operating under RTE-IVB. However, the structure of the program system (strict separation of acquisition and reduction, store raw data as acquired, routines to verify the data system, etc.) is of more general interest, and allows the system to be applied to any test rig. The introduction of a "program control

20. array" accelerates execution and provides means for communication between programs, which otherwise execute individually.

SCHOOL
CALIFORNIA 93943

ABSTRACT

A system of data acquisition and reduction programs, TXCO is described. The programs were written for the transonic compressor test facility at the NPS Turbopropulsion Laboratory which is served by an HP1000 series computer operating under RTE-IVB. However, the structure of the program system (strict separation of acquisition and reduction, store raw data as acquired, routines to verify the data system, etc.) is of more general interest, and allows the system to be applied to any test rig. The introduction of a "program control array" accelerates execution and provides means for communication between programs, which otherwise execute individually.

ACKNOWLEDGMENT

This study was made possible by Professor Ray Shreeve, Director of the Turbopropulsion Laboratory (TPL) of the Department of Aeronautics, and by Professor Dr. Ing Heinz Gallus, Institute for Aero Engines and Turbomachines of the Technical University Aachen, West Germany; to both I express my thanks. Jim Hammer, the TPL Laboratory Manager, contributed to this program system by letting me share his brilliant knowledge and vast experience in the areas of instrumentation and turbomachines.

TABLE OF CONTENTS

		Page No.
1.	INTRODUCTION	6
2.	GUIDE TO THE PROGRAM DESCRIPTIONS	10
3.	PROGRAM TXCOØ	13
	3.1. Flow Chart of Program TXCOØ	13
	3.2. Program Listing, TXCOØ	29
4.	PROGRAM TXCO1	43
	4.1. Description	43
	4.2. Subroutine ABSRV	53
	4.3. Subroutine CALIB	62
	4.4. Subroutine FREER	70
	4.5. Subroutine PACER	84
	4.6. Program Listing, TXCO1	104
5.	PROGRAM TXCO2	133
	5.1. Description	133
	5.2. Subroutine COMB	140
	5.3. Subroutine STDY	154
	5.4. Program Listing, TXCO2	169
6.	PROGRAM TXCO3	186
	6.1. Description	186
	6.2. Subroutine CHECK	192
	6.3. Subroutine CHNGE	209
	6.4. Program Listing, TXCO3	218
7.	UTILITY SUBROUTINE PACKAGE TXCOU	229
	7.1. Description	229
	7.2. Program Listing, TXCOU	241
8.	DATA REDUCTION PROGRAMS	259
9.	CONCLUSIONS AND RECOMMENDATIONS	260
APPENDIX A.	DATA ACQUISITION WORK SHEETS	262
	A1. Data Locations	263
	A2. Steady State Data Array	265
	A3. Program Control Array (CNTRL)	267
	A4. Paced Data Array	269
APPENDIX B.	LINEAR APPROXIMATION BY METHOD OF LEAST SQUARES	270
REFERENCES		273

1. INTRODUCTION

This report describes a system of data acquisition and reduction programs, designed to acquire data from the Turbopropulsion Laboratory's transonic compressor test facility. The computer hardware consists of an HP21MX mini computer with various peripheral devices. Both steady-state and high speed data are required to be taken as scheduled during a compressor test. The entire hardware configuration is shown in Fig. 1.

At the outset, the system of computer programs was required to do the following:

(i) Control via the "Interface Bus", measurement devices such as Scanivalves (S/V's), Scanivalve controllers, scanners, digital voltmeters (DVM), digital counters, analog to digital converters, and the acquisition timing device called PACER.

(ii) Perform data acquisition as efficiently as possible, store data in disc files, and document the test conditions.

(iii) Provide a means to check the data system (e.g., SUBROUTINE CHECK, Section 6.2).

(iv) Provide a means to verify the raw data (e.g., SUBROUTINE PICTR, called from SUBROUTINE PACER, Section 4.5. PICTR uses the auxiliary terminal to display the acquired wave form).

(v) Provide a means for the operator to communicate interactively. Since the operator at the system console is usually the investigator or research engineer and not a computer specialist, the program flow and the programmed interactive messages were required to be clear, logical and easy to understand.

The demand to speed up the data acquisition conflicted with the requirement of keeping the dialogue between program and operator clear. Interactive programs necessarily have extensive input-output operations which slow down the execution of the program. A reasonable compromise between these two choices was the introduction of a "program control array", CNTRL, whose elements - once pre-assigned - relieved the operator from entering routine decisions (e.g., telling the subroutines FREER and PACER how many Kulite signals are to be recorded and where to locate them; see Appendix A3: CNTRL(23Ø) through CNTRL(246)). Additionally the control array provides accounting data (e.g., the sequential number for raw data files).

In the present report complete documentation is given of the program system "TXCO". The system consists of a "father" program, TXCOØ, which, in operation, calls on a series of "son" programs TXCO1, TXCO2 or TXCO3.

The father program, TXCOØ, offers the investigator a menu of program branches to be scheduled according to a single digital entry as follows:

1.	Survey using the type 'A' and the type 'B' Kulite semiconductor pressure probes (Ref 1 and 2).	ABSRV
2.	On-line calibration type 'A' and type 'B' probe.	CALIB
3.	Acquisition of high speed data through the fast A/D converter, which is operated in free run mode.	FREER
4.	Acquisition of high speed data through the fast A/D converter, which now is controlled by a timing device, the PACER (Ref 3).	PACER
5.	Radial flow survey using a temperature-pneumatic four hole COMBINATION PROBE.	COMB
6.	Acquisition of all steady state data.	STDY
7.	Check the instrumentation.	CHECK
8.	Change the program control array.	CHNGE
9.	Reduce high speed data from the 'A' - 'B' probe system. REDAB uses the data gathered by ABSRV.	REDAB
10.	Reduce flow data from the combination probe. REDCO uses the data gathered by COMB.	REDCO
11.	Reduce steady state data and add this operating point to the compressor performance map. REDST uses the data gathered by STDY.	REDST

The investigator selects the desired program module by entering the appropriate number between 1 and 11. Entering 12 halts the program. Subroutines ABSRV, CALIB, FREER and PACER - they handle the high speed data - are contained in PROGRAM TXCO1 (Section 4). Subroutines COMB and STDY - they handle the steady state data - are contained in PROGRAM TXCO2 (Section 5). Subroutines CHECK and CHNGE - they are used by the operator to control the program flow and verify the data system - are contained in PROGRAM TXCO3 (Section 6). After the select code is entered, and verified either by entering an additional parameter or tapping the [RETURN] key, the "father" program suspends its operation while the desired "son" program (TXCO1, TXCO2 or TXCO3) executes. The entire TXCO-system works interactively with the operator and displays as many informative messages as possible.

The program descriptions in the following sections explain, in user-manual form, how to handle each subroutine. The descriptions often resemble each other, which in the interests of utility was deliberately not avoided. A compressor failure prevented the author from using the programs for compressor test runs. The report is therefore presented with only a very short section of conclusions and recommendations. The program system is not considered to have been perfected, since little experience has been gained with its operation other than in "dry" runs.

2. GUIDE TO THE PROGRAM DESCRIPTIONS

Detailed descriptions of the programs are given in the following sections. First, in Section 3, a flow chart and listing are given for the father program TXCOØ. Then, the descriptions given in Sections 4 through 6 (of TXCO1 through TXCO3) are structured as follows:

PROGRAM XXXX (or SUBROUTINE XXXX): PURPOSE:
A brief description of the purpose of this particular program module is given, and its capabilities and restrictions are noted.

ARGUMENTS: If the program module is a subroutine, which is called with parameters, the parameter list is explained.

EXTERNALS: The externals of each program module are listed. This information is necessary when loading the relocatable binary version (indicated by the % sign as first character of the disc file name under the RTE-IV operating system).

COMMON BLOCKS: The members of the COMMON blocks and their length in 32-bit words are listed and explained.

MNEMONIC ABBREVIATIONS: The mnemonic acronyms which each program module uses are listed and explained.

ERROR MESSAGES: If a salvageable error occurs during the execution of a program module, an error message with suggestions for how to resolve the problem are described.

PROCEDURE: This subsection, which should always be used together with the flow chart, describes how to go through the program module. Hints for how to utilize all program features are given.

DATA FILE: The date file name is explained for all program modules, which save data. The first two characters are typical for the type of data which the file contains; for example,

Data File Name	Type of Data	Created By
T1rrss	'A'-'B' probe survey	ABSRV
T2rrss	free run sample	FREER
T3rrss	paced run sample	PACER
T4rrss	all raw steady state data	STDY
T5rrss	combination probe survey	COMB

rr — # of test run

ss — sequential # of data file type

The following modules are synchronized through the data file:

Data Reduction Program		File Name		Data Acquisition Program
REDAB	↔	T1rrss	↔	ABSRV
REDST	↔	T4rrss	↔	STDY
REDCO	↔	T5rrss	↔	COMB

VARIABLES: All variables, their type (REAL or INTEGER) and length (only if the variable is used as an array), together with a brief description, are listed.

The flow chart and a FORTRAN-IV compiler listing of the program module complete each description.

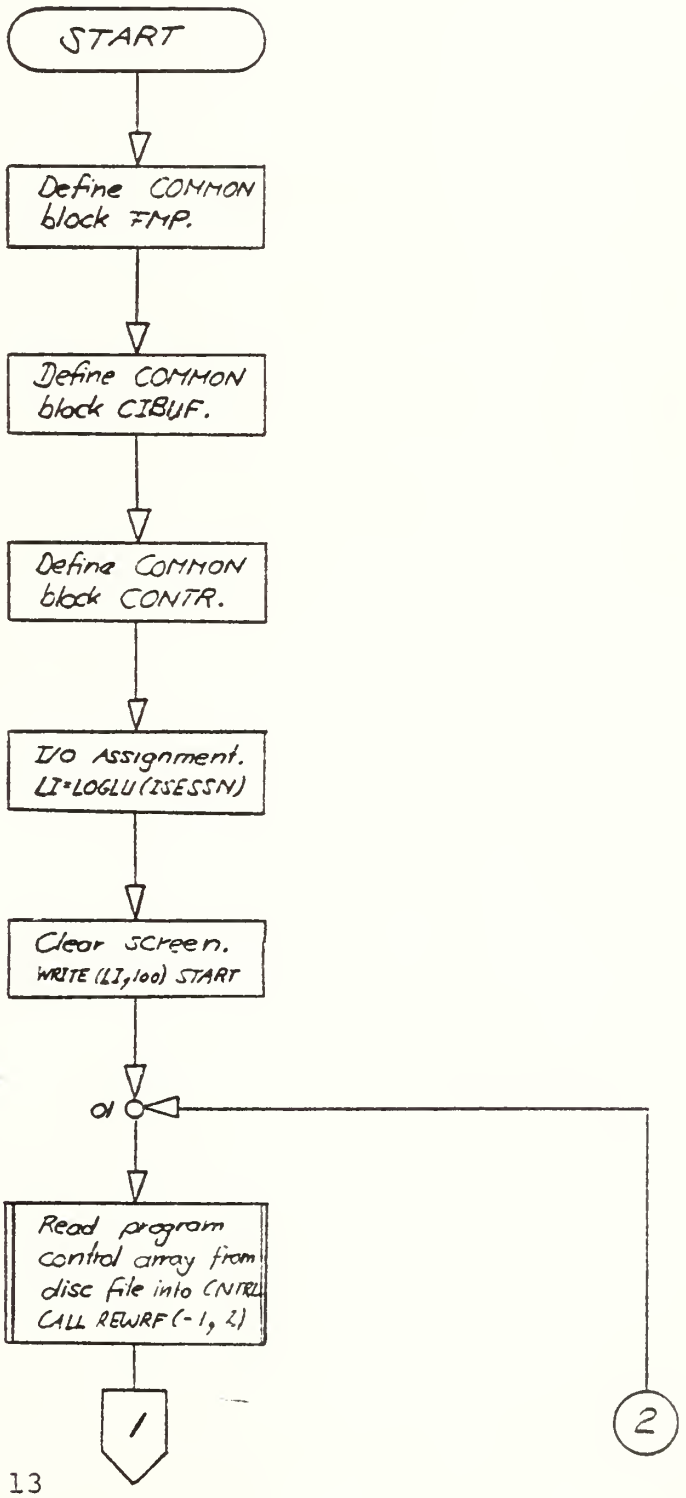
The source codes of programs TXCOØ, TXCO1, TXCO2 and TXCO3 are available in the disc files &TXCOØ, &TXCO1, &TXCO2 and &TXCO3. Since TXCO1, TXCO2 and TXCO3 use common subroutines and functions, the latter are grouped together in file &TXCOU, where the "U" indicates the following "utility" program modules:

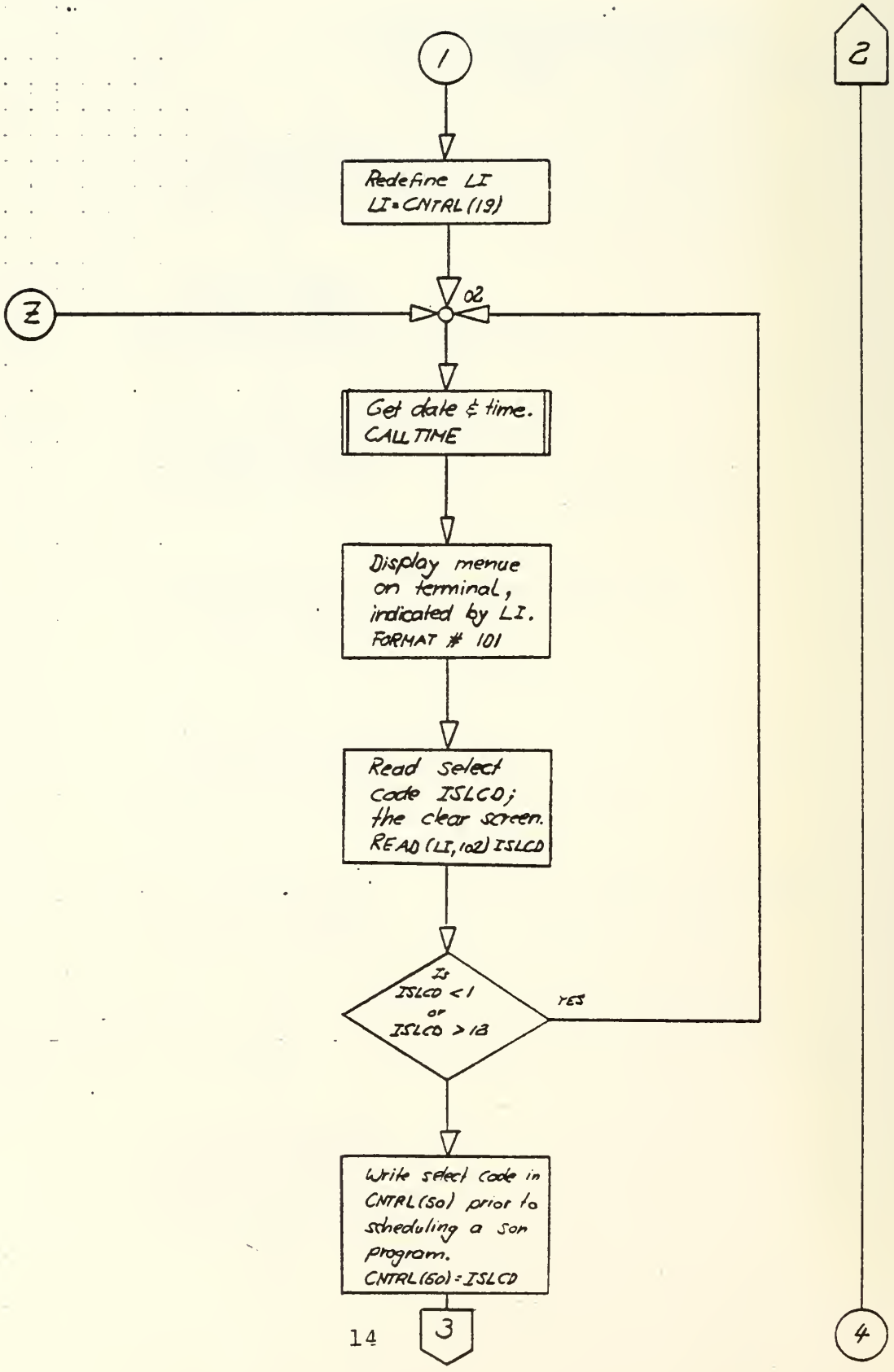
ACQN	Positions S/V and reads DVM.
CNTL	Closes scanner channel.
CURVE	Compute linear curve fit.
ICON	Converts two-digit INTEGER to ASCII-string.
IPORT	Interrogates S/V.
PICTR	Use CRT to display the acquired data.
REWRF	Data transfer disc ↔ array.
RPACE	Triggers A/D through PACER.
SCANR	Closes scanner channel and reads SVM, counter.
TIME	Gets date and time → ASCII-string.
WAIT	Causes a defined time delay.

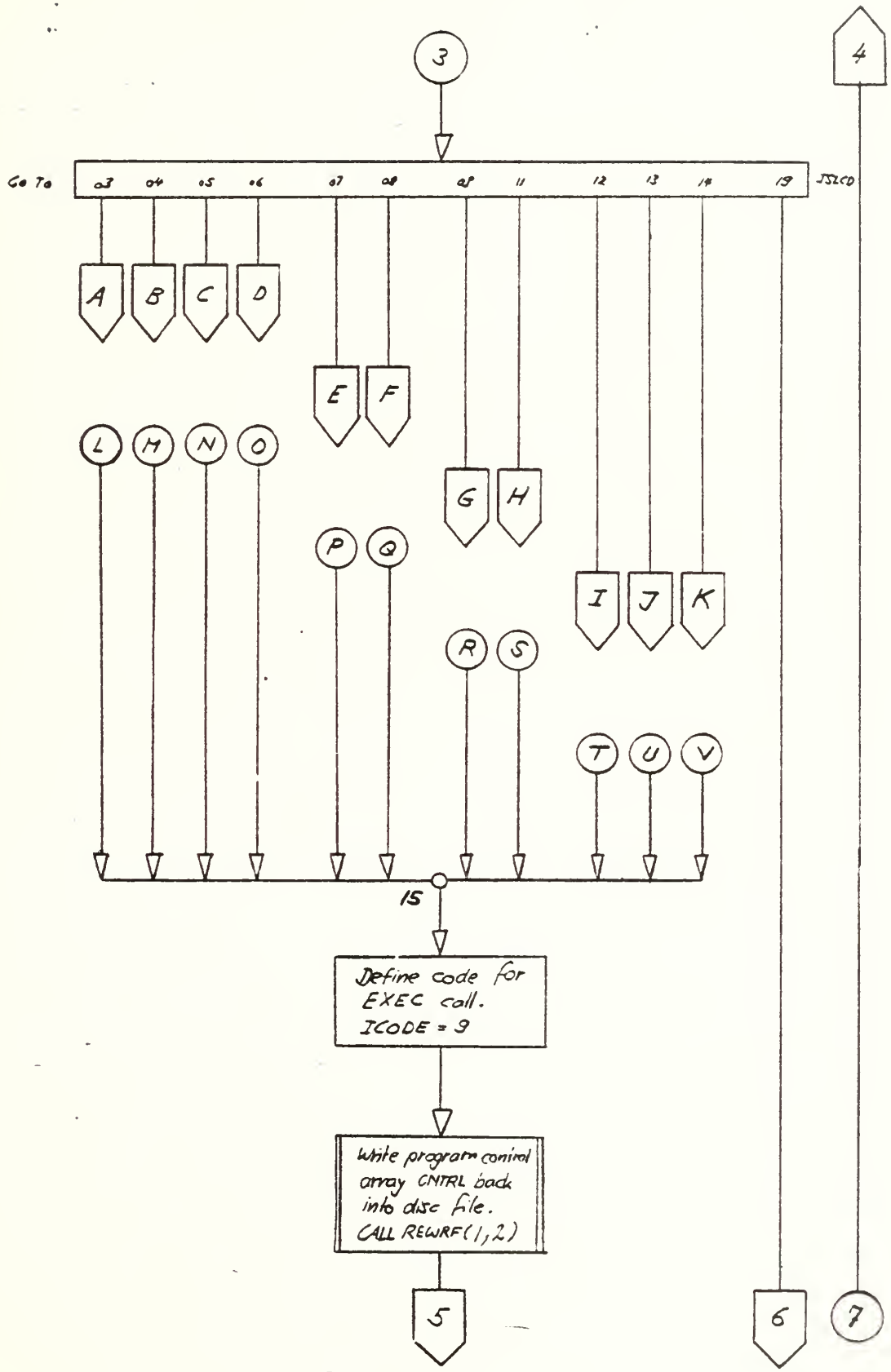
When loading %TXCO1, %TXCO2 or %TXCO3, the relocatable binary utility file %TXCOU must also be loaded in order to satisfy the externals. The modules of TXCOU are described in Section 7, but in less detail than the programs in Sections 4 through 6.

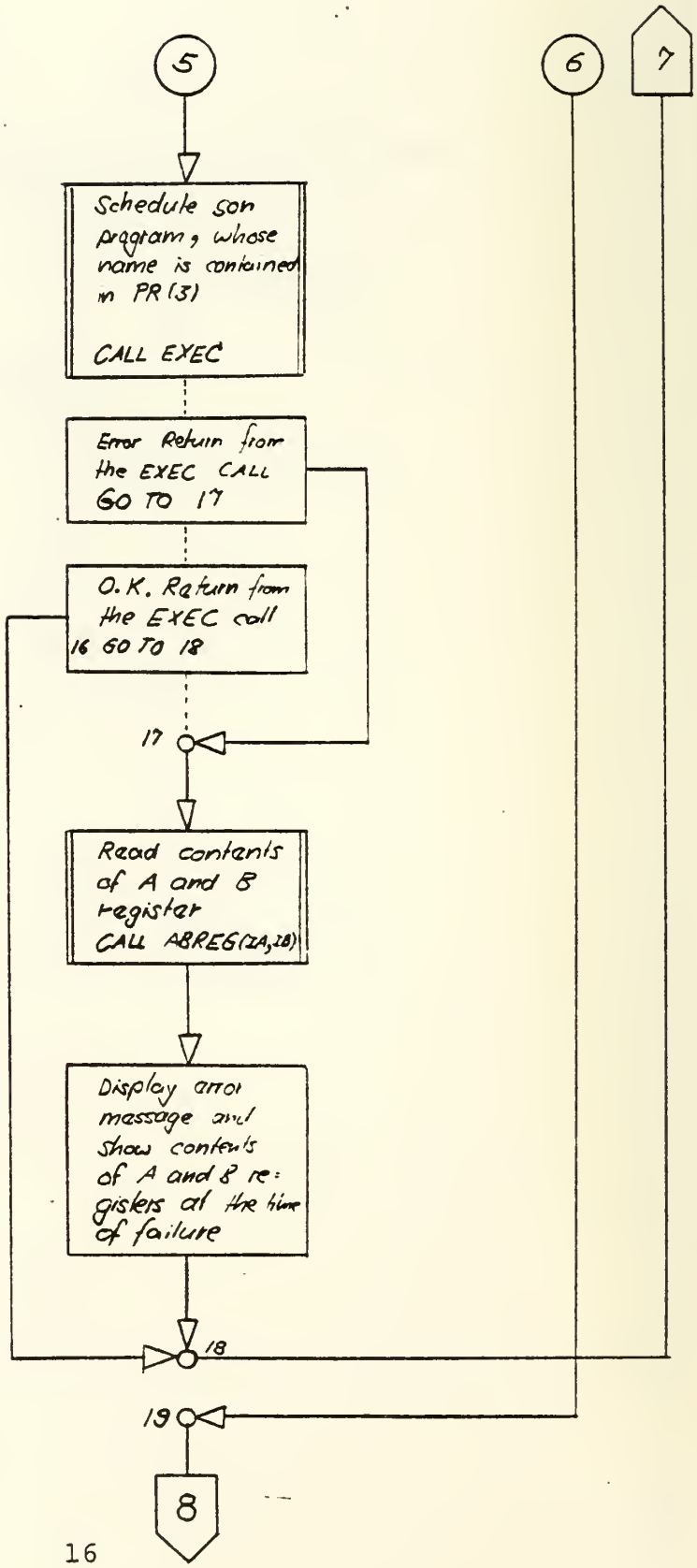
3. PROGRAM TXCOM

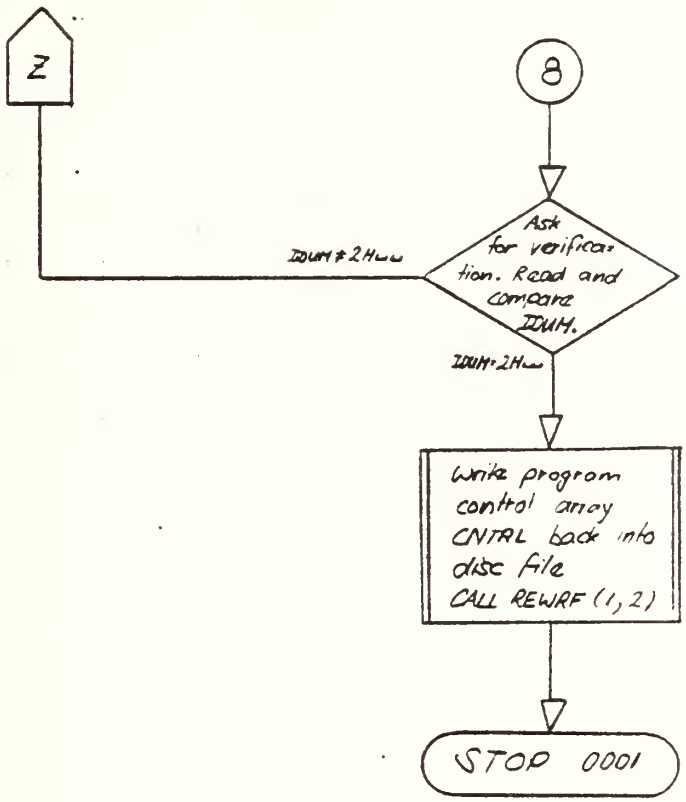
3.1. FLOW CHART PROGRAM TXCOM:



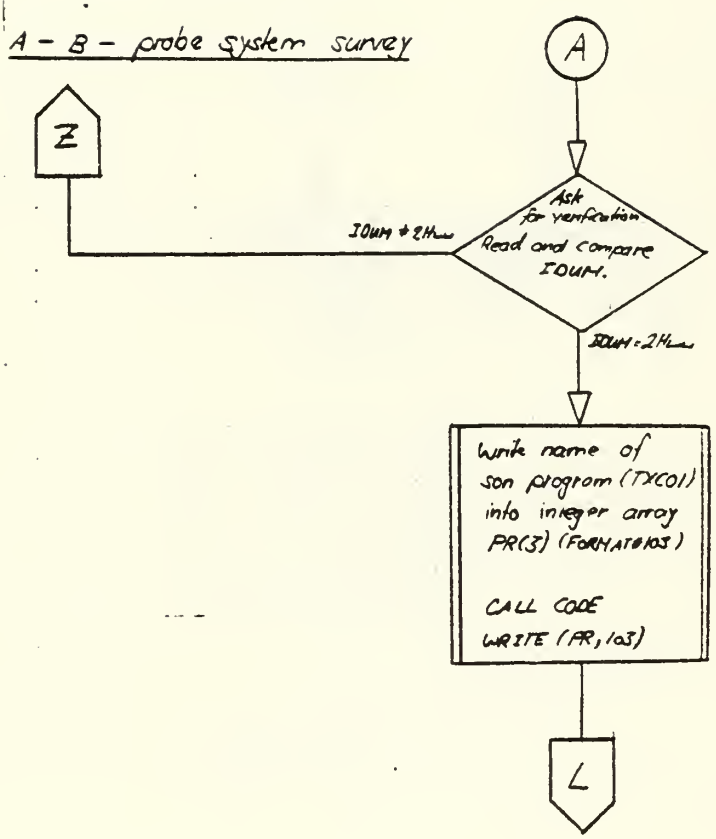

1
2
Redefine LI
LI=CNTRL(19)
02
Z
Get date & time.
CALL TIME
Display menue
on terminal,
indicated by LI.
FORMAT # 101
Read select
code ISLCD;
the clear screen.
READ(LI,102)ISLCD
Is
ISLCD < 1
or
ISLCD > 13
YES
Write select code in
CNTRL(50) prior to
scheduling a son
program.
CNTRL(50)=ISLCD
3
4

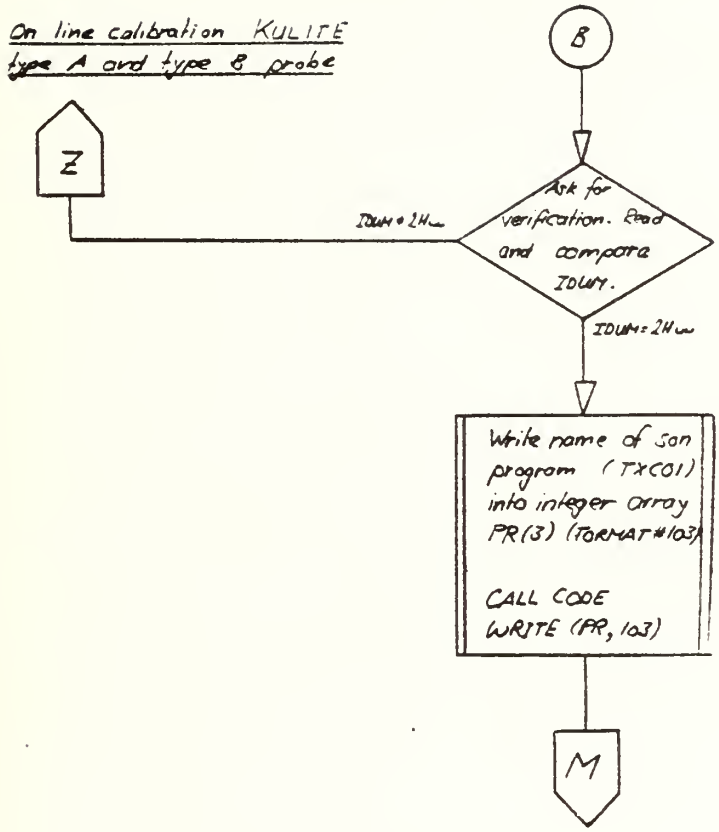

3
4
Go To
03
04
05
06
07
08
09
11
12
13
14
19
ISLCO
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
15
Define code for EXEC call. ICODE = 9
Write program control array CNTRL back into disc file. CALL REWRF(1,2)
5
6
7


5
6
7
Schedule son program, whose name is contained in PR(3)
CALL EXEC
Error Return from the EXEC CALL GO TO 17
O.K. Return from the EXEC call
16 GO TO 18
17
Read contents of A and B register
CALL ABREG(2A,2B)
Display error message and show contents of A and B registers at the time of failure
18
19
8

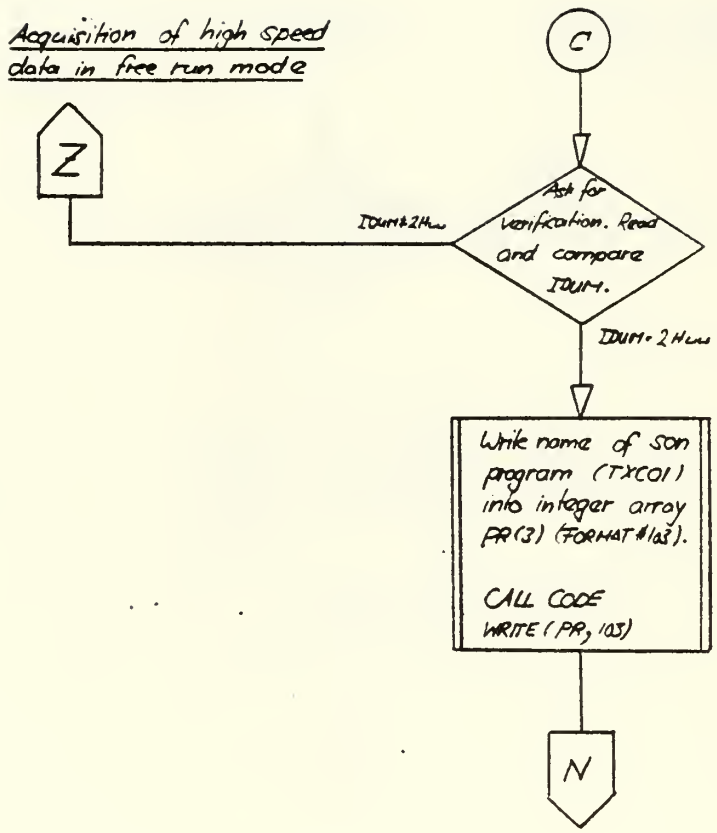

Z
8
Ask for verification. Read and compare IDUM.
IDUM≠2H
IDUM=2H
Write program control array CNTRL back into disc file
CALL REWRF (1,2)
STOP 0001

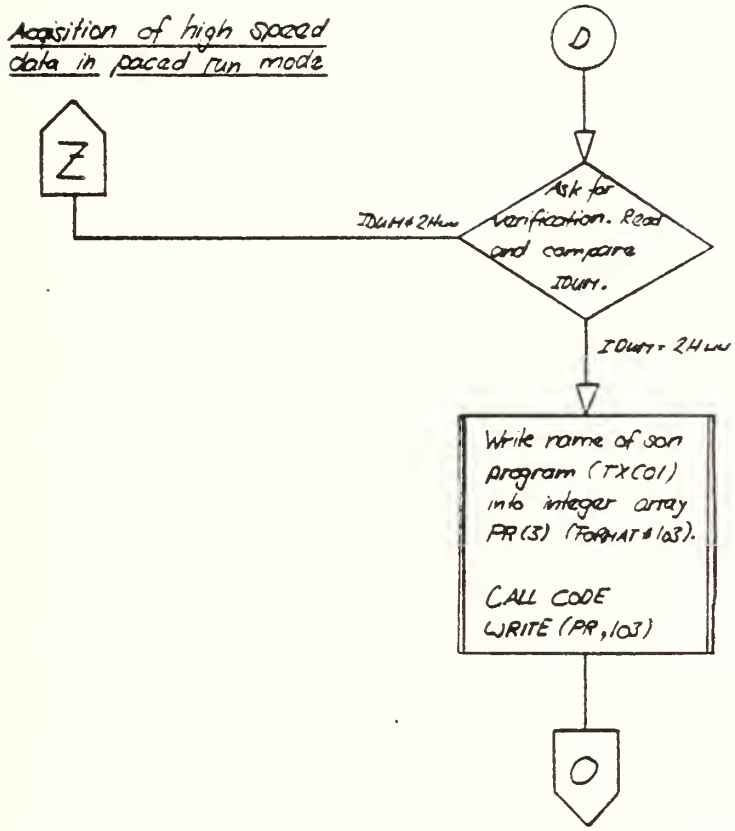
A - B - probe system survey



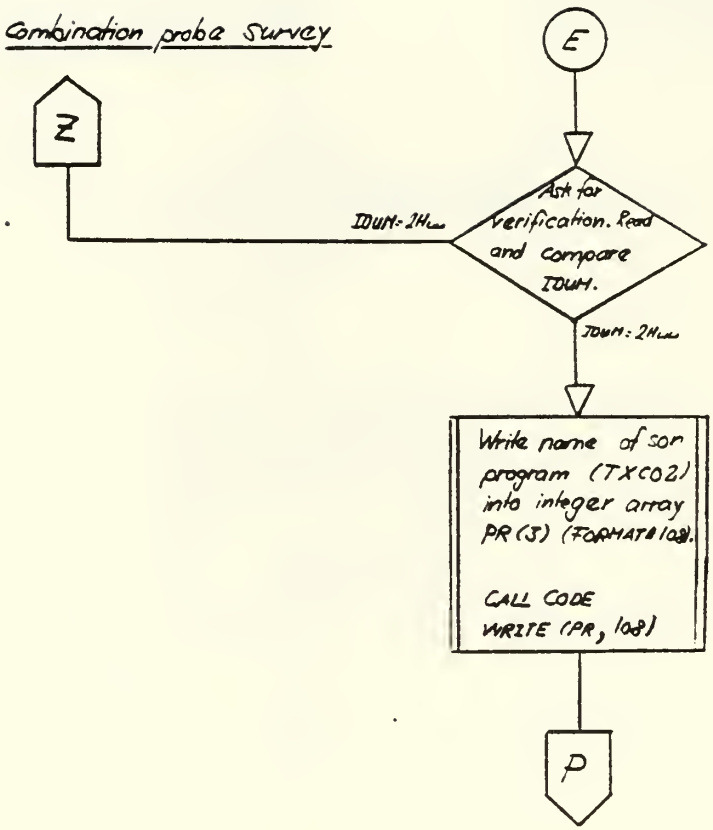

On line calibration KULITE
type A and type B probe
B
Z
Ask for verification. Read and compare IDUM.
IDUM = 2Hω
IDUM = 2Hω
Write name of son program (TXC01) into integer array PR(3) (FORMAT #103)
CALL CODE
WRITE (PR, 103)
M

Acquisition of high speed data in free run mode

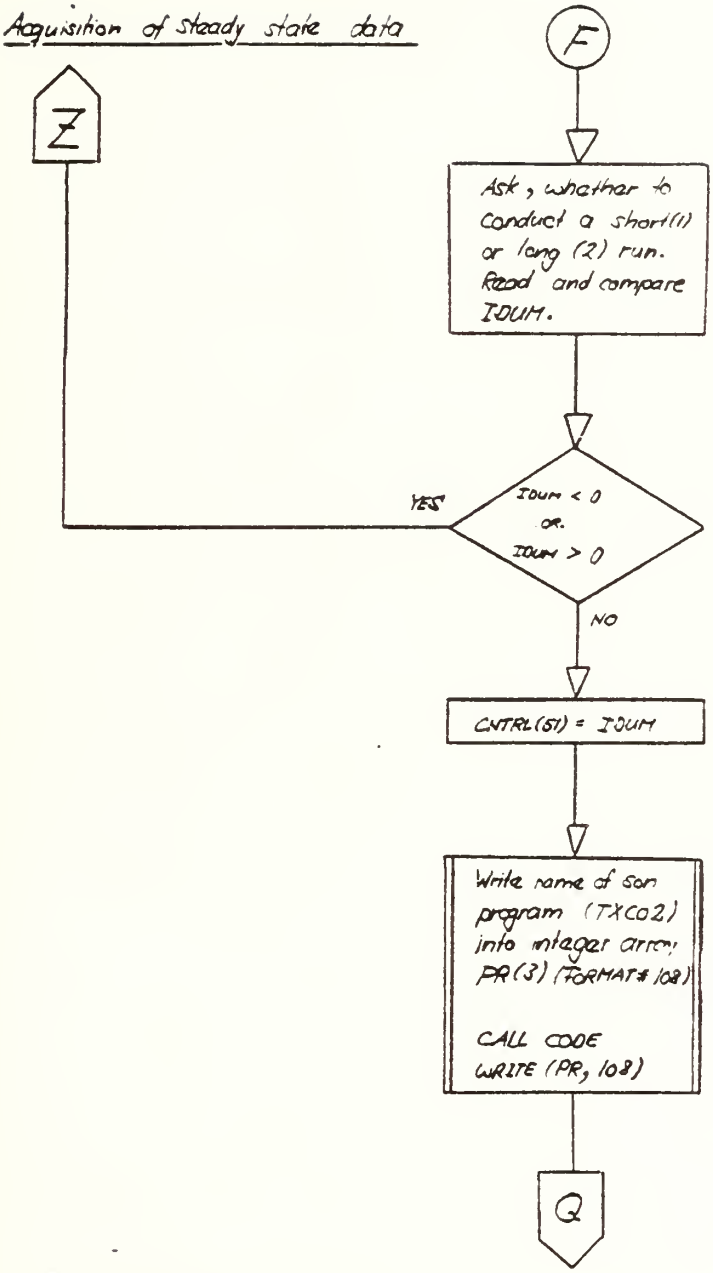



Acquisition of high speed data in paced run mode
D
Z
Ask for verification. Read and compare IOUT.
IOUT≠24hex
IOUT=24hex
Write name of son program (TXC01) into integer array PR(3) (FORMAT #103).
CALL CODE WRITE (PR,103)
O

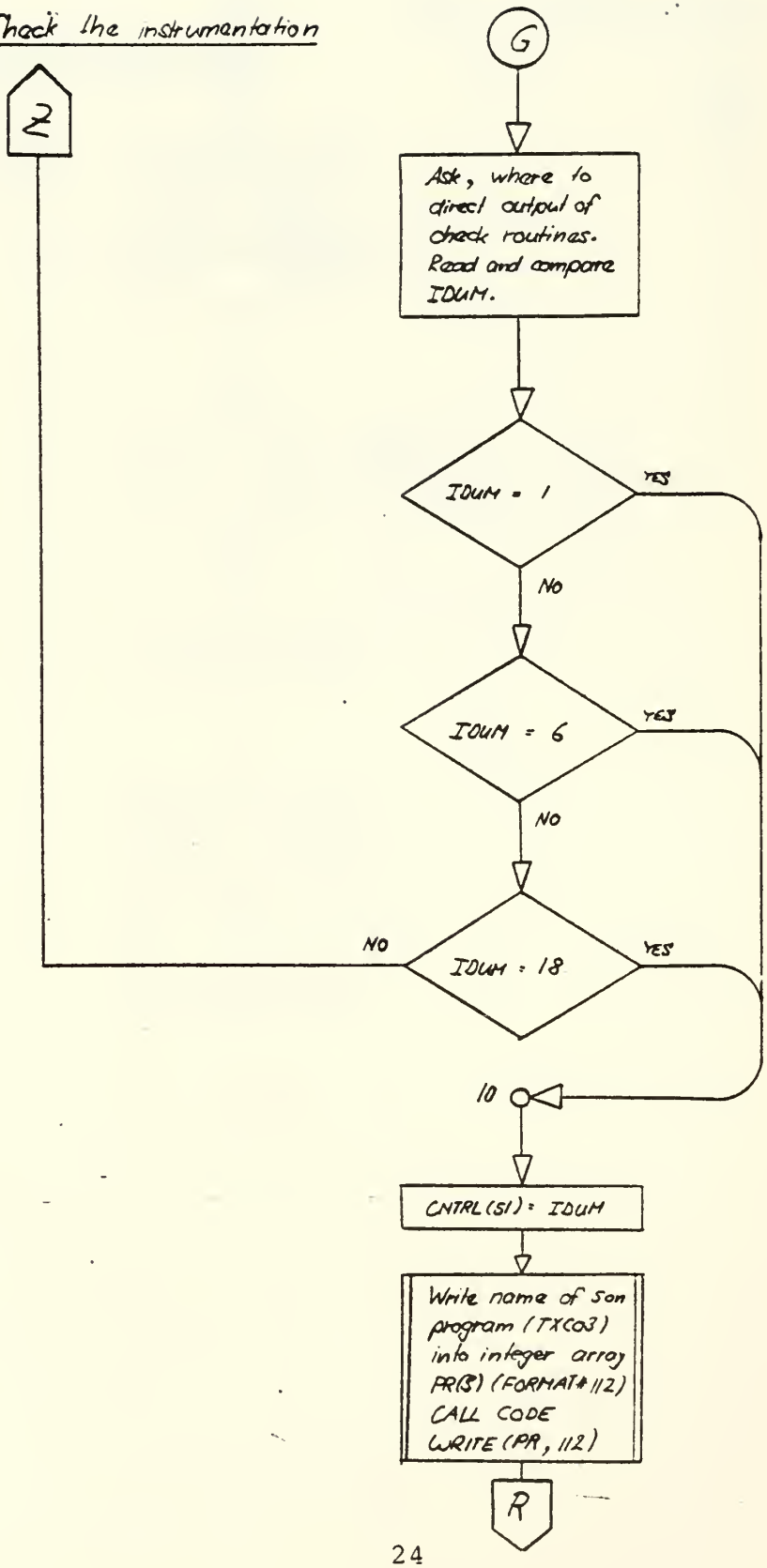
Combination probe survey



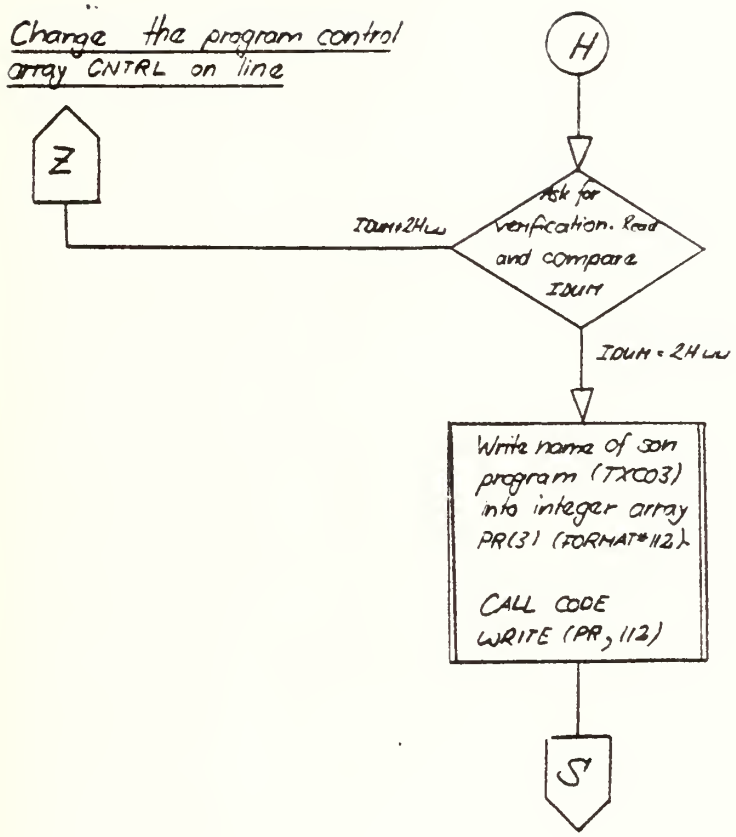
Acquisition of steady state data

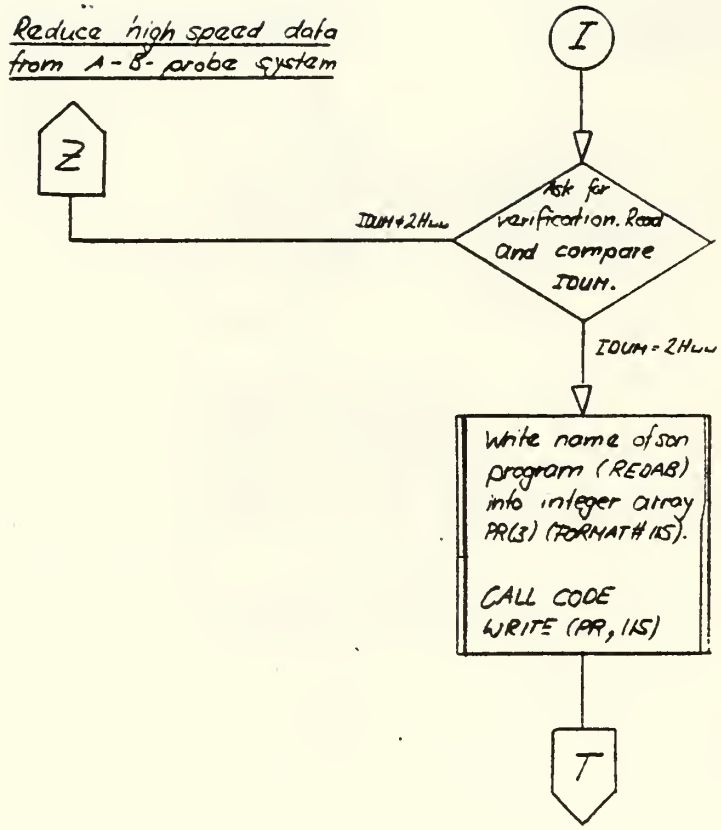

F
Ask, whether to conduct a short(1) or long (2) run. Read and compare IOUM.
IOUM < 0 OR. IOUM > 0
YES
NO
Z
CNTRL(51) = IOUM
Write name of son program (TXCO2) into integer array PR(3) (FORMAT # 108)
CALL CODE WRITE (PR, 108)
Q

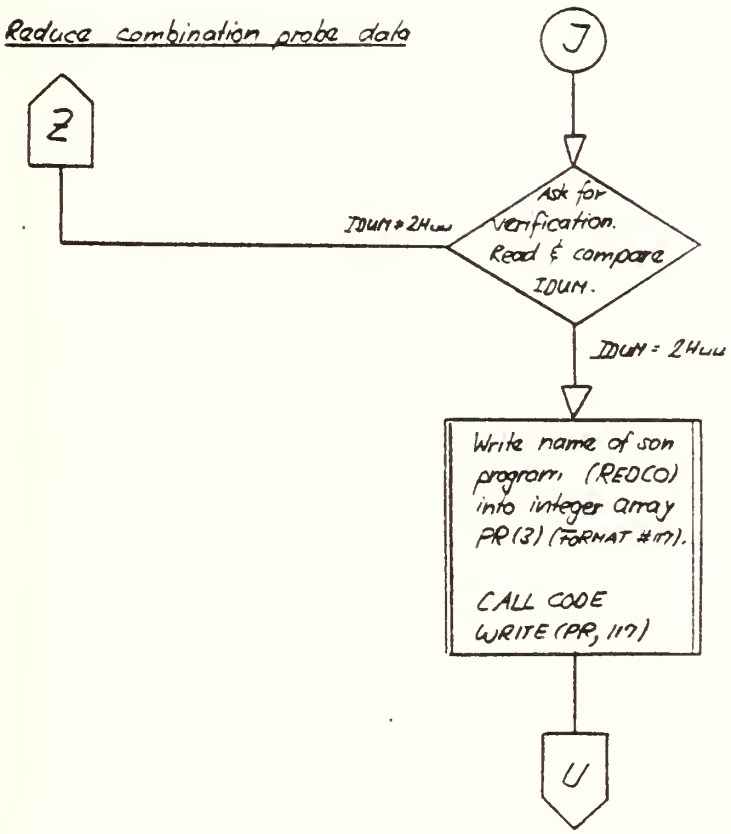
Check the instrumentation

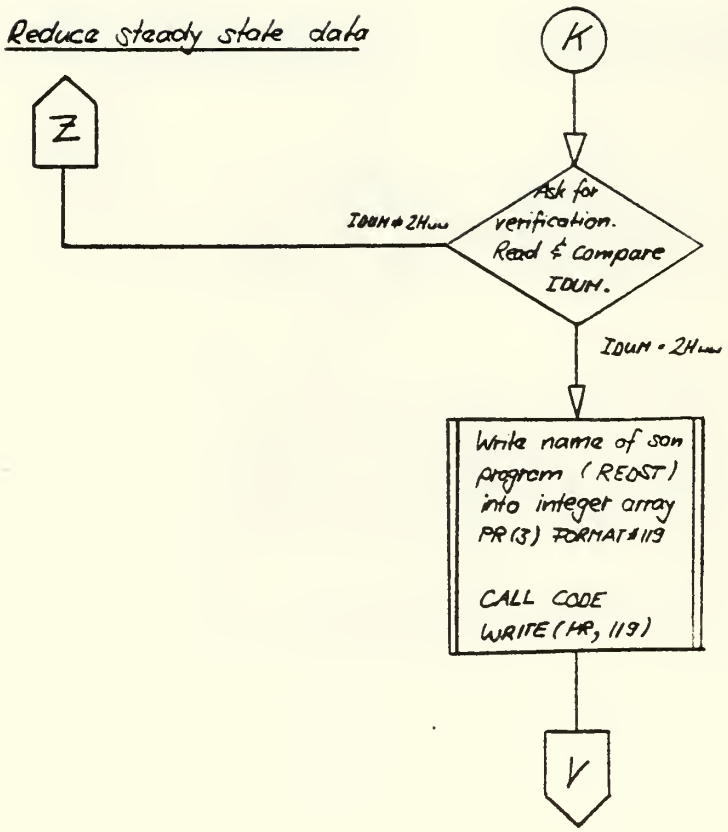


Change the program control array CNTRL on line




Reduce high speed data from A-B- probe system
I
Z
IDUM+2Hᵤᵤ
Ask for verification. Read and compare IDUM.
IDUM=2Hᵤᵤ
Write name of son program (REDAB) into integer array PR(3) (FORMAT#115).
CALL CODE
WRITE (PR, 115)
T


Reduce combination probe data
J
Z
Ask for verification. Read & compare IDUM.
IDUM ≠ 2Hωω
IDUM = 2Hωω
Write name of son program (REDCO) into integer array PR(3) (FORMAT #117).
CALL CODE
WRITE (PR, 117)
U


Reduce steady state data
K
Z
Ask for verification. Read & compare IDUM.
IDUM ≠ 2Hₒₒ
IDUM = 2Hₒₒ
Write name of son program (REOST) into integer array PR(3) FORMAT #119
CALL CODE
WRITE(HR, 119)
V

3.2. PROGRAM LISTING, TXCOØ

```
PAGE 0001  FTN.   [illegible]

0001  FTN4,L
0002        BLOCK DATA
0003        [illegible]
0004        COMMON /[illegible]/ [illegible]
0005        INTEGER IDCB(144),IBUFF(3),IBUF(2)
0006        END

  FTN4 COMPILER: [illegible]

  ** NO WARNINGS ** NO ERRORS **

BLOCK COMMON FWA     SIZE =  0015
```

```
 PAGE 0002  FTN,    3:26 PM  MON.,  11  AUG.,  1980

0007           BLOCK DATA
0009          *  / CIBUF / IBUF(16*1)
0009           COMMON / CIBUF / IBUF
0010           INTEGER IBUF(1664)
0011           END

  FTN4 COMPILER: HP92060-16092 REV. 1924  (80430)

  **  NO WARNINGS **  NO ERRORS **

 BLOCK COMMON CIBUF   SIZE =  0:664
```

```
PAGE 0003  FTN.   9:2? AM  MON., 11  AUG    1?80

0012          BLOCK DATA
0013         *-- / CONTR / CNTRL(256)

0014          COMMON / CONTR / CNTRL
0015          INTEGER CNTRL(256)
0016          END

  FTN4 COMPILER: HP92060-16092 REV. 1925 (790430)

  **  NO WARNINGS **  NO ERRORS  **

BLOCK COMMON CONTR  SIZE =  0025
```

```
0017          PROGRAM TXC00 (3,99)
0018    C     ....^.....
0019    C     .
0020    C     .  Data acquisition transsonic compressor.
0021    C     .
0022    C     .....
0023          *, Data acquisition transsonic co-processor

0024          COMMON / CONTR / CNTRL
0025          INTEGER CNTRL(256) IDCB(144),BP(3)
0026          INTEGER NOLF,NUCR(3),ICLR(3) START(3)
0027
0028          DATA NOLF   /0065720/
0029          DATA NOCR   /0000033B,0401B"B/
0030          DATA ICLR   /0155246,0155136,0065720/
0031          DATA START /0155106,0155136,0155206/
0032
0033
0034    C     FORMATS TXC00 START
0035       100 FORMAT (3A2"  TXC00 : START")
0036       101 FORMAT (/" Transsonic Compressor (pressure) 00: Test run #
0037          * "I2",   Test #"I2" Main Program "2A2"
0038          *" "A2","A2"("/" Select next step, please . . ."
0039          *"   1 ____ A - B - probe system survey (Y/N) "2A2"
0040          */
0041          *"   2 ____ On line calibration with tape A and tape B "2A2
0042          *" "CX" CALIB"/
0043          *"   3 ____ Acquisition of high speed data on tape "2A2
0044          *"12X" TAPE"/
0045          *"   4 ____ Acquisition of high speed data on disc "2A2
0046          * "11X" PACE"/
0047          *"   5 ____ Combination probe survey "3SX" CP"/
0048          *"   6 ____ Acquisition of steady state data "2A2
0049          *TDY"/
0050          *"   7 ____ Check the instrumentation "3A2" CHECK"/
0051          *"   8 ____ Change the program control array "2A2
0052          * "11X" CHNGE"/
0053          *"   9 ____ Reduce high speed data from A - B - probe system
0054          * "11X" REDAB"/
0055          *"  10 ____ Reduce data from the combination probe "2A2"
0056          * "EDCO"/
0057          *"  11 ____ Reduce steady state data "3SX" CPDP"/
0058          *"  12 "5IX" STOP 0001"//
0059          *" Select desired program module  Enter select no "
0060          * "2A2)
0061       102 FORMAT (I2)
0062
0063       103 FORMAT ("TXC0" ")
0064       104 FORMAT (" A - B - probe system survey?  Verify!"2A2
0065       105 FORMAT (" On line calibration CALIB tape A and tape B prob
0066          *erify!"2A2)
0067       106 FORMAT (" Acquisition of high speed data on tape mode "2A2
0068          * all right?"2A2)
0069       107 FORMAT (" Acquisition of high speed data on tape mode "2A2
0070          *R all right?"2A2)
0071
0072       108 FORMAT ("TXC02 ")
0073       109 FORMAT (" Combination probe survey?  Use Cal"2A2
0074       110 FORMAT (" Acquisition of steady state data, Comp (1) or Shaft
0075          *) run?    "2A2)
0076       111 FORMAT (I1)
0077
0078       112 FORMAT ("TXC03 ")
0079       113 FORMAT (" Check the instrumentation.  Output to LU
0080          *"2A2)
0081       114 FORMAT (" Change control array  CNTRL on line?  Verify!"2A2)
0082
0083       115 FORMAT ("REDAB ")
0084       116 FORMAT (" Reduce high speed data from A - B - probe system.  Ve
0085          *fy!"2A2)
0086
```

```
0097      117 FORMAT ("REDCO ")
0098      118 FORMAT (" Reduce data from the combination probe  ",A1)
0099
0090      119 FORMAT ("RESET ")
0091      120 FORMAT (" Reduce steady state data? Use Full"/A2)
0092
0093      121 FORMAT ("  TXC00 : SPECIFIC "ON" (A1)  ",A1)
0094      122 FORMAT ("  TXC00 : FILES TO BE COLLECTED "  ",A1,"  ",A1,"  ",A1,"
0095     *1  R RESTART "ON" ",A2,"  ",A1,"  ",A1,"  ",A1,"  ",A1)
0096      123 FORMAT (" STOP 0001 ? Verify"/A2)
0097      124 FORMAT (A1,"  ",A1)
0098      149 FORMAT (A1,A1)
0099  C       FORMATTED  TXC00  SETUP
0100
0101            LI = LOC (ICSESSN)
0102            CNTRL(19) = 'LI'
0103            WRITE (LI,101) START
0104        01  CALL REDFS (-1,2)
0105            LI = CNTRL(19)
0106        02  CALL TIME (IMON,IDAY,IYEAR,IHOUR,IMIN)
0107            WRITE (LI, 101) CNTRL(1),CNTRL(2),CNTRL(3)      IMON,IDAY,IYEAR,
0108           *IHOUR,IMIN,NOCP
0109            READ (LI, 103) FILES
0110            WRITE (LI, 104) (LI, I=1,24)
0111            IF ( ICOLD .EQ. 'NO' ) GO TO 01
0112
0113            CNTRL(3) = FALSE
0114            GO TO (01,03,04,05,06,07,08,09,10,11,12,13,14),
0115
0116  C         .....  ..  .....  .  ..  ..  .  .
0117  C
0118  C         .   A = 2 = Probe Fusion Survey.
0119  C         .
0120  C
0121        03  WRITE (LI, 105)
0122            READ (LI, 106) ID
0123            WRITE (LI, 107) ID
0124            IF ( IDNUM .NE. 2HA ) GO TO 02
0125            CALL CODE
0126            WRITE (PR, 103)
0127            GO TO 15
0128
0129  C         .....  .  .  .  .....  .  .  .  .  .  .  .  .  .  .  .  .  .
0130  C         .
0131  C         .   On line calibration (ALL IF ONLY A B type P probe)
0132  C         .
0133  C
0134        04  WRITE (LI, 105) MODE
0135            READ (LI, 106) IDNUM
0136            WRITE (LI, 107) IDNUM
0137            IF ( IDNUM .NE. 2B ) GO TO 02
0138            CALL CODE
0139            WRITE (PR, 103)
0140            GO TO 15
0141
0142  C         .....  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
0143  C         .
0144  C         .   Acquisition of high speed data in real time mode
0145  C         .
0146  C         .....  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
0147        05  WRITE (LI, 105) MODE
0148            READ (LI, 106) IDNUM
0149            WRITE (LI, 107) IDNUM
0150            IF ( IDNUM .NE. 2H ) GO TO 03
0151            CALL CODE
0152            WRITE (PR, 103)
0153            GO TO 15
0154
0155  C         .....  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
0156  C         .
```

```
0157   C      . 'Acquisition of high speed data in paired and mode
0158   CC     .
0159   CC     ..... ... ... 
```

```
PAGE 0007  TXC00  9:35 AM  MON   11  JUL , 1980

0227   C       . ..Reduce high speed data from A - B - probe system.
0228   C       .
0229   C       .....  .....  .....  
```

PAGE 0009 TXC00 9:36 AM MON., 11 AUG., 1980

** NO WARNINGS ** NO ERRORS ** PROGRAM = 01991 , COMMON = 00000

```
PAGE 0009  FTN    9:76 AM  MON,  11  DEC,  1980

0292          INTEGER FUNCTION ICON (I,N)
0293    C     ...............................  ...  ...  ...  ...  ...  ...  ...
0294    C
0295    C     .  Converts integer numbers into ASCII strings.
0296    C     .  Author:     Ron W. Semmens
0297    C     .  Date:       January 15, 1979
0298    C     .  Because of the simplicity of the program the program
0299    C     .  description is included in the code.
0300    C     .  I, N    ...    integer number to be coded.
0301    C     .  IC      ...    integer number to be converted into ASCII
0302    C     .  ICON    ...    2 = character ASCII string to be returned
0303    C     .
0304    C     ...............................  ...  ...  ...  ...  ...  ...  ...
0305          *  Converts integer to ASCII string
0306       100 FORMAT (I2)
0307
0308          IC = I+N
0309          IF ( IC .LT. 10 ) IC = IC + 48
0310
0311          CALL CODE
0312          WRITE (ICON,100) IC
0313          RETURN
0314
0315       01 ICON = IC+100*0B
0316          RETURN
0317          END

FTN4 COMPILER  [redacted]

** NO WARNINGS **  NO ERRORS  *  [redacted]
```

```
0318          SUBROUTINE REWRF (IDCBR IWHATA)
0319    C     .....
0320    C     .
0321    C     .  This subroutine reads (IDCBR = +1) or writes (IDCBR = -1) a
0322    C     .  of a array specified by IWHATA.
0323    C     .  Author:    Hans M. Zehner
0324    C     .  Date  :    February 23, 1990
0325    C     .  Detailed program description is available in TYCO log.  The
0326    C     .  Comment statements match to the flow chart of options.
0327    C     .
0328    C     .....
0329          *, Data transfer disc    area".
0330          COMMON / CIBUF / IBUF
0331          COMMON / CONTR / CNTRL
0332    C     COMMON / CO    / A
0333          COMMON / CMD   / IDCB,IFILE ISIZE ISECU,ICR
0334    C     REAL A(25)
0335          INTEGER IBUF(1-64)
0336          INTEGER IDCB(144),IFILE(3),ISIZE(2)
0337          INTEGER MODE,WORD(3),COLR(3)
0338          DATA MODE  /00S32B/
0339          DATA NOD9  /00003B/ 0000433B/
0340          DATA ICLR  /01S43B 0000S5B 00SB7B/
0341    C     FORMATS  REWRF  SUBROUTINE
0342      101 FORMAT (" REWRF : ARRAY TYPE(1-4)    OR FILE
0343         *,00:24")
0344.     102 FORMAT (" REWRF : DISC FILE TO(B,OR    SECT/ TRACK
0345      103 FORMAT (" REWRF   ARRAY CNTR(2:5)    OR FILE / FIRST
0346         *)
0347      104 FORMAT (" REWRF : DISC FILE CNTR(1,2) =   SPACE (B,W) OR
0348         *)
0349      105 FORMAT (" REWRF : ARRAY A(25)    DISC FILE A
0350      106 FORMAT (" REWRF : DISC FILE AT:00:24   ARRAY )
0351      107 FORMAT (" REWRF : E ZED WITCH    WHAT, = "
0352      108 FORMAT (" I/O ")
0353      109 FORMAT ("DATA_E")
0354      110 FORMAT (" AS     ")
0355      121 FORMAT (" CALL OPEN  (IDCB,IERR,"3A2","I3","1","I3","I4"
0356         *)  failed; STOP"3A2"")
0357      122 FORMAT (" CALL LOCF  (IDCB,IERR,IBUM,IBUM,IBUM,I4,"I4") I
0358         *BUM,IBUM,ISIZE(2)) failed; STOP""
0359      123 FORMAT (" CALL SignAL (IDCB,IERR,    failed; STOP"I3"
0360      124 FORMAT (" CALL READF (IDCB,IERR,IBUF,"I3","I3","I3",  fa
0361         *iled; STOP"23X"")
0362      125 FORMAT (" CALL WRITF (IDCB  IERR,TRUE,"I3","I3","I3",  fa
0363         *iled; STOP"23X"")
0364      126 FORMAT (" CALL READF (IDCB  IERR,CNTRL,"I3","I3","I3",  fa
0365         *iled; STOP"23X"")
0366      127 FORMAT (" CALL WRITF (IDCB,IERR,CNTRL,"I3","I3","I3")  fa
0367         *iled; STOP"24X"")
0368      129 FORMAT (" CALL READF (IDCB,IERR,A "I3","I3","I3")  failed
0369         *; STOP"27X"")
0370      129 FORMAT (" CALL WRITF (IDCB,IERR,A,"I3","I3","I3")  failed
0371         *; STOP"26X"")
0372      130 FORMAT (" CALL CLOSE (IDCB,IERR,0)  failed; STOP"40X""
0373         *)
0374          LI = LOCLU(ISESSN)
0375          ISECU = 0
0376          ICR = 25
0377      -   IF ( IWHATA .LT. 1 .OR.  IWHATA .GT.  2 ) GO TO 10
0378          GO TO (10,20) IWHATA
0379
0380
0381
0382    C     .....
0383    C     .
0384    C     .  Integer array IBUF being written back and forth.
0385    C     .
0386    C     .....
0387       10 CALL CODE
```

```
 PAGE 0011  PEURF  9:?A AM  MON,  1)  GUC   1980

0388          WRITE (TFILE,108)
0389          CALL OPEN  (IDCB,IERR,IFILE,IOPTN,ISECU,IOPT1,IR
0390          IF ( IERR  .NE.  0 ) GO TO 11
0391          WRITE (LI, 102) IFILE,IOPTN,ISECU,IOPT1,IOPT2
0392          STOP 1
0393       11 CALL LOCF  (IDCB,IERR,IDUM,IDUM,IDUM,IR,IC,1)  ! A DUMMY RE
0394          IF ( IERR  .NE.  0 ) GO TO 12
0395          WRITE (LI, 105)
0396          STOP 2
0397       12 CALL RWNDF (IDCB,IERR)
0398          IF ( IERR  .NE.  0 ) GO TO 13
0399          WRITE (LI, 127)
0400          STOP 3
0401       13 ISIZE(1) = ISIZE(1)*2
0402          IL          = ISIZE(1)*ISIZE(2)
0403          IF ( IREWD  .EQ.  -1 ) GO TO 14
0404          IF ( IREWD  .EQ.  +1 ) GO TO 15
0405       14 CALL READF (IDCB,IERR,IBUF,IL)
0406          IF ( IERR  .GE.  0 ) WRITE (LI, 101)
0407          IF ( IERR  .NE.  1 ) GO TO 16
0408          WRITE (LI, 134) IL, EN NUM
0409          STOP 4
0410       15 CALL WRITF (IDCB,IERR,IBUF,IL)
0411          IF ( IERR  .GE.  0 ) WRITE (LI, 103)
0412          IF ( IERR  .GE.  0 ) GO TO 16
0413          WRITE (LI, 135) IL, EN NUM
0414          STOP 5
0415       16 CALL CLOSE (IDCB,IERR,0)
0416          IF ( IERR  .GE.  0 ) GO TO 17
0417          WRITE (LI, 136)
0418          STOP 6
0419       17 RETURN
0420
0421
0422
0423 C        ... ... ...
```

```
0458          WRITE (LI, 150)
0459          STOP 16
0460       27 RETURN
0461
0462
0463
0464    C     ..... .....
0465    C     .                                                                .
0466    C     .  Real array A being written back and forth.                    .
0467    C     .                                                                .
0468    C     ..... .....
0469    C  30 CALL CODE
0470    C     WRITE (IFILE,110)
0471    C     CALL OPEN  (IDCB,IERR,IFILE,IOPTN,ISECU,ICR,IDCBS)
0472    C     IF ( IERR  .GE.  0 ) GO TO 31
0473    C     WRITE (LI, 121) IFILE,IOPTN,ISECU,ICR,IDCBS
0474    C     STOP 21
0475    C  31 CALL LOCF  (IDCB,IERR,IDUM,IDUM,IDUM,ISIZE(1),IDUM,IDUM,ISIZE(2),
0476    C     IF ( IERR  .GE.  0 ) GO TO 32
0477    C     WRITE (LI, 122)
0478    C     STOP 22
0479    C  32 CALL RWNDF (IDCB,IERR)
0480    C     IF ( IERR  .GE.  0 ) GO TO 33
0481    C     WRITE (LI, 123)
0482    C     STOP 23
0483    C  33 ISIZE(1) = ISIZE(1) * 2
0484    C        ISIZE(2) = ISIZE(2) * ISIZE(1)
0485    C     IF ( IERR  .LT.  0 ) GO TO 34
0486    C     IF ( IRECP  .LT.  0 ) GO TO 35
0487    C  34 CALL READF (IDCB,IERR,A,ISIZE(2))
0488    C     IF ( IERR  .GE.  0 ) WRITE (LI, 136)
0489    C     IF ( IERR  .GE.  0 ) GO TO 36
0490    C     WRITE (LI, 139) IL, EN, NUM
0491    C     STOP 24
0492    C  35 CALL WRITF (IDCB,IERR,A,IL)
0493    C     IF ( IERR  .GE.  0 ) WRITE (LI, 135)
0494    C     IF ( IERR  .GE.  0 ) GO TO 37
0495    C     WRITE (LI, 139) IL, EN, NUM
0496    C     STOP 25
0497    C  36 CALL CLOSE (IDCB,IERR,0)
0498    C     IF ( IERR  .GE.  0 ) GO TO 37
0499    C     WRITE (LI, 139)
0500    C     STOP 26
0501    C  37 RETURN
0502
0503
0504
0505    C     ..... .....
0506    C     .                                                                .
0507    C     .  Error;  IWHATA is not defined.                                .
0508    C     .                                                                .
0509    C     ..... .....
0510       40 WRITE (LI, 107) IWHATA
0511          IWHATA = -IWHATA
0512          RETURN
0513          END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 01146 COMMON = 00000

```
PAGE 0013  FTN,    9:36 AM  MON., 11  AUG.,  1980

0514          SUBROUTINE TIME (IMON,IDAY,IYEAR,IHOUR,IMIN,ISEC)
0515  C       .....
0516  C       .
0517  C       .  Get date and time and convert the variables to ASCII
0518  C       .
0519  C       .....
0520         *, Gets date and time,  ASCII string.
0521          COMMON /CNTR/ FILE
0522          INTEGER ITIME(5)
0523          INTEGER ONE(256)
0524      90  FORMAT (" ERROR DETECTED IN PROGRAM TIME"/
0525         *        " CALL EXEC (11,ITIME)")
0526
0527          IMON = SHR$5
0528          IDAY = SHR$5
0529          IYEAR= SHR$5
0530          IHOUR= SHR$5
0531          IMIN = SHR$5
0532          ISEC = SHR$5
0533          CALL EXEC (11+100000B,ITIME)
0534          GO TO 02
0535       01 GO TO 03
0536       02 CALL ABREG (IA,IB)
0537          GO TO 04
0538       03 IMON  = IOR(ONTR(1),0)
0539          IDA   = IOR(ONTR(2),0)
0540          IYEAR = IOR(ONTR(3),0)
0541          IHOUR = IOR(ITIME(4),0)
0542          IMIN  = IOR(ITIME(5),0)
0543          ISEC  = IOR(ITIME(6),0)
0544          RETURN
0545       04 WRITE ( 6, 90) IA,IB
0546          RETURN
0547          END

FTN4 COMPILER: B9920-60003 REV. 1936  (B1430)

**  NO WARNINGS **  NO ERRORS **  PROGRAM = 00122        IMON = 00000
```

```
EMP     10042 10370    / EMP    / IRCB(14)  [illegible] (SIZE/2) WCU,ICB
CIBUF   10421 13420    / CIBUF  / IBUF(16*n)
CONTR   13471 14070    / CONTR  / CNTRL(256)

TXCOO   14071 17777    Data acquisition transsonic compressor

ICON    20000 20043    Converts integer to ASCII-string.
REWRF   20044 22235    Data transfer disc     area.
TIME    22236 22457    Gets date and time     ASCII string

LOGLU   22460 22535    93067-14262 REV.1901 790228
READF   22536 23177    93067-16173 REV.1901 790219
OPEN    23500 23775    93067-16125 REV.1901 790215
CLOSE   23776 24205    93067-16128 REV.1901 791229
CLRIO   24206 24214    750701  24000-16001
ARREG   24215 24233    750701  24000-16001
OVRD.   24234 24237    93067-16126 REV.1901 790504
$SMVE   24240 24334    93067-16[illegible] REV.1901 790201
LOCF    24335 24627    93067-16125 REV.1901 791130
RWNDF   24630 24711    93067-16125 REV.1901 790924
LURQ    24715 25277    93067-16[illegible] REV.1901 790222
.DADS   25300 25407    750818  24000-16001
.DMP    25410 25535    750819  24000-16001
.DDI    25554 26054    791031  24000-16001
SESSN   26057 26073    93067-16125 REV.1901 790427
R/W.    26076 26237    93067-16[illegible] REV.1901 790213
P.PAS   26241 26263    93067-16[illegible] REV.1901 790501
.DNC    26267 26322    790315  24000-16001
PAUSE   26327 26335    771102  24000-16001
$ALRM   26341 26511    93067-16[illegible] REV.1901 790211
FMTIO   26512 30030    24000-16001 REV.1901 790417
.DDF    30031 30033    791012  24000-16001
.DIN    30034 30036    790815  24000-16001
.EBT    30041 30071    771102  24000-16001
PAU.E   30072 30076    750701  24000-16001
$OPEN   30077 30247    93067-16125 REV.1901 790103
PU$UP   30250 30345    93067-16125 REV.1901 790103
RWND$   30346 30430    93067-16125 REV.1901 790103
FRMTS   30431 34274    24000-16001 REV.1901 790103
FMT.E   34275 34477    24000-16001 REV.1901 790103
REIO    34460 34534    93067-16263 REV.1901 790516
RMPAR   34535 34547    791106  24000-16001
PNAME   34550 34635    791031  24000-16001
LUTRU   34636 34744    93067-16254 REV.1901 790223
$GETD   34745 34774    791105  24000-16001
.OPER   34775 35047    750701  24000-16001
.LBT    35050 35100    760518  24000-16001

12 PAGES RELOCATED     12 PAGES READ     NO ERRORS THIS     NO ERRORS MADE
LINKS:BP    [illegible]  LOADFILE    [illegible]
/LOADR:TXCOO  READY AT  9:41 AM  MON,  1- AUG  1981

 /LOADR:$EXD
```

4. PROGRAM TXCO1

4.1. DESCRIPTION

TXCO1 is a son program of the father program TXCOØ, by which it is scheduled, if one of the following operations is desired:

1 - A - B - probe system survey

2 - On line calibration, KULITE type 'A' and 'B' probes

3 - Acquisition of high speed data in free run mode

4 - Acquisition of high speed data in paced run mode.

When scheduled by TXCOØ, which suspends operation while the son program TXCO1 executes, the program TXCO1, reads the program control array from the disc, sets the HP interface bus and the measurement and control devices to remote control and programs the Digital Voltmeter (DVM), the scanners and the counter. CNTRL (50) is the actual decision variable to select and call the subroutine, which performs the desired operation. When this subroutine has terminated, the interface bus and the devices are released from remote control and the control array is written into a disc file, so that the next TXCO module can read it. The correct termination of each subroutine can be verified by checking the stop codes. Note, that each stop coding ending on 77 indicates correct execution of a subroutine.

CNTRL (50)	Subroutine	STOP Code
1	ABSRV	TXCO1 : STOP 0177
2	CALIB	TXCO1 : STOP 0277
3	FREER	TXCO1 : STOP 0377
4	PACER	TXCO1 : STOP 0477

Any other STOP code indicates an error and utilizing a program list the operator can trace the problem. The first two digits of the STOP code are typical for the subroutines. An example: the program stops at STOP code 0304; the first two digits read 3 and this tells the operator that it was subroutine FREER which ran into trouble, because the ending two digits read 04, which is different from 77; a program list uncovers that the failure occurred while writing into a disc file using FMP (File Management Package) subroutine WRITF near line 1005. STOP codes are crucial for a complex program system in order to rapidly detect and salvage problems, even during a test run.

EXTERNALS: REWRF, ABRT, RMOTE, ABSRV, CALIB, FREER, PACER, CLEAR, LOCL

COMMON BLOCKS: CONTR, CIBUF, FMP

FORTRAN conventions for the HP21MX computer request COMMON blocks to be predefined in a BLOCK DATA subroutine prior to using a COMMON block in a program, subroutine or function.

BLOCK DATA subroutine	arrays & variables	length in words
CONTR	CNTRL	400B = 256
CIBUF	IBUF	3200B = 1664
FMP	IDCB,IFILE,ISIZE,ISECU,ICR	227B = 151

The COMMON block CONTR allocates the space for the control array CNTRL. A key to decode the individual elements of CNTRL can be found in the Appendix.COMMON block CNTRL is designed to take the largest raw data array - IBUF (1664) in subroutine

FREER - even if other subroutines only partially use the space, allocated by the block CIBUF. The arrays and variables allocated by the COMMON block FMP are frequently used for the data transfer from and to the disc. Since each individual subroutine saves the data prior to terminating, more than one subroutine or function may use the same buffer area.

MNEMONIC ABBREVIATIONS: None

ERROR MESSAGES: If CNTRL (50) is less than 1 or greater than 4, no subroutine can be selected and the program terminates, outputting an error message (FORMAT 102) to the terminal.

PROCEDURE: For more detailed information study the flow chart and the information given in the section PURPOSE.

DATA FILE: None

VARIABLES IN BLOCK DATA CONTR:

CNTRL (256)	integer	program control array.

VARIABLES IN BLOCK DATA CIBUF:

IBUF (1664)	integer	buffer array for the raw data.

VARIABLES IN BLOCK DATA FMP:

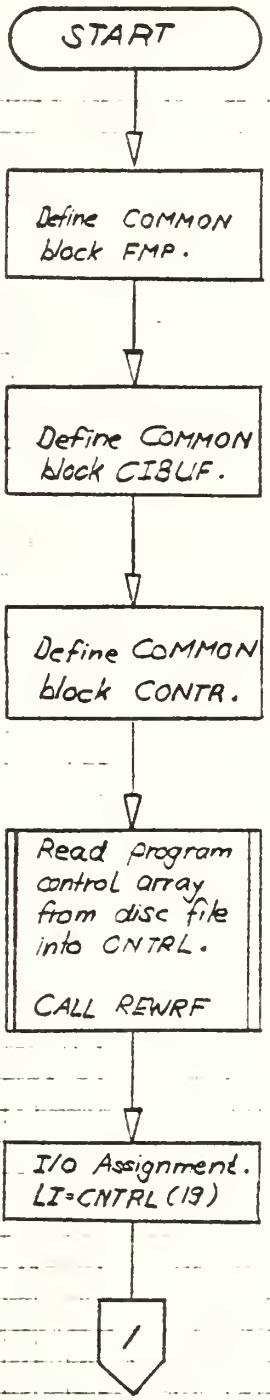
IDCB (144)	integer	data control block.
IFILE (3)	integer	array to contain file name.
ISIZE (2)	integer	array to contain # of records in the first and record length in 16-bit-words in the second word.

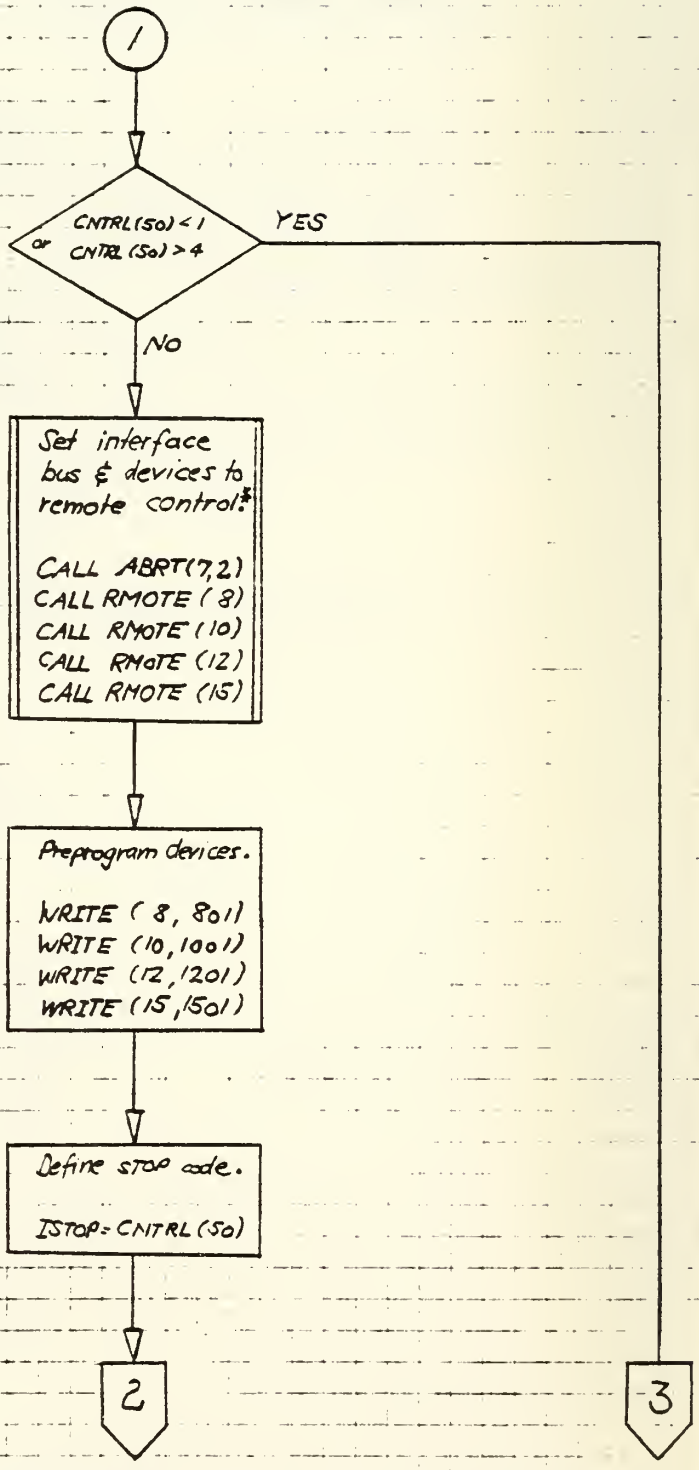
ISECU	integer	security code of data file.
ICR	integer	cartridge reference number, where data file is located.

VARIABLES IN PROGRAM TXCO1:

CNTRL (256)	integer	program control array.
NOLF	integer	suppresses line feed.
LI	integer	LU3 of standard input device (terminal).
ISTOP	integer	control variable to select STOP code.
X1	real	dummy variables.
X2	real	
X3	real	

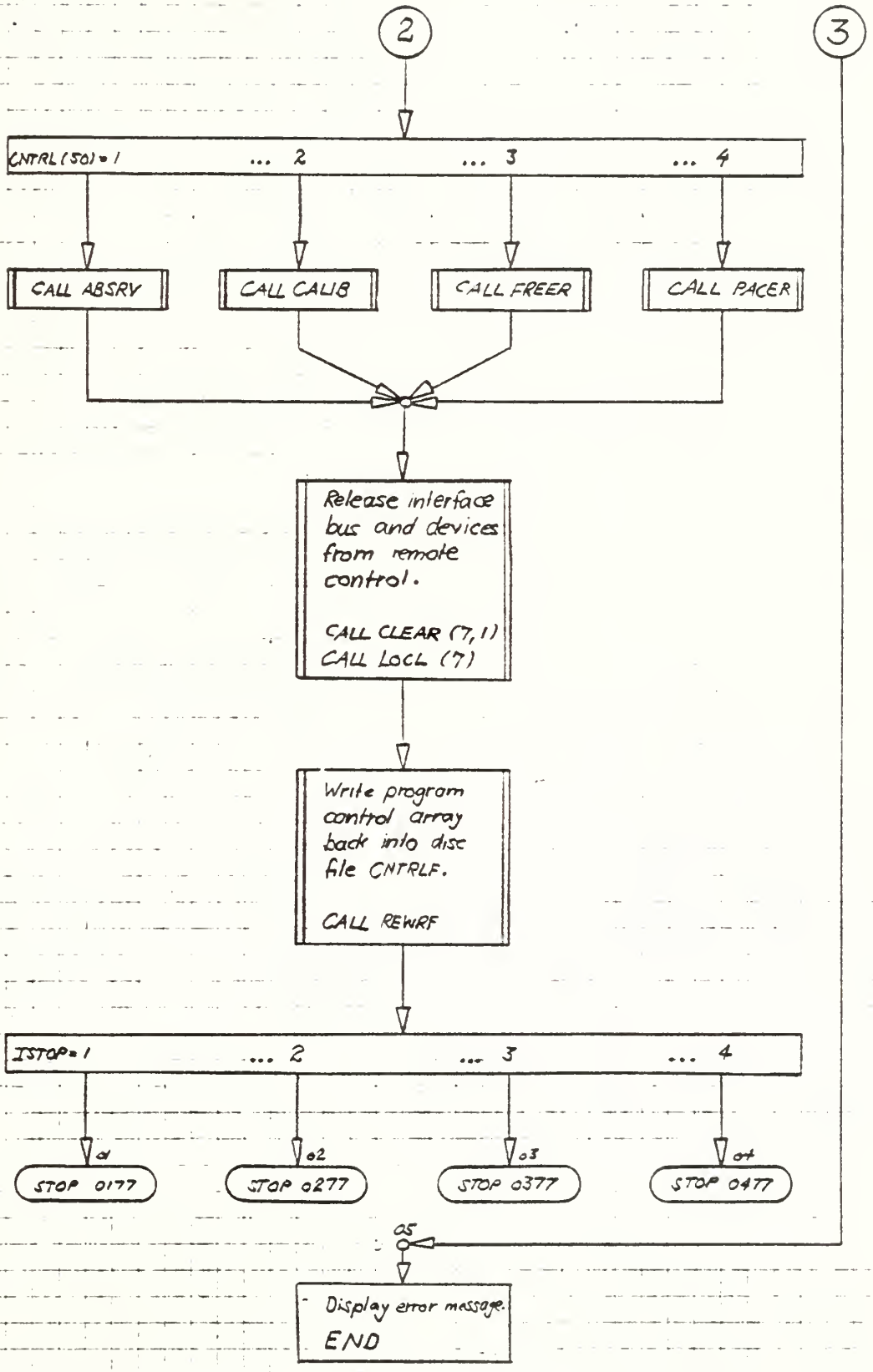
FLOW CHART PROGRAM TXC01 :

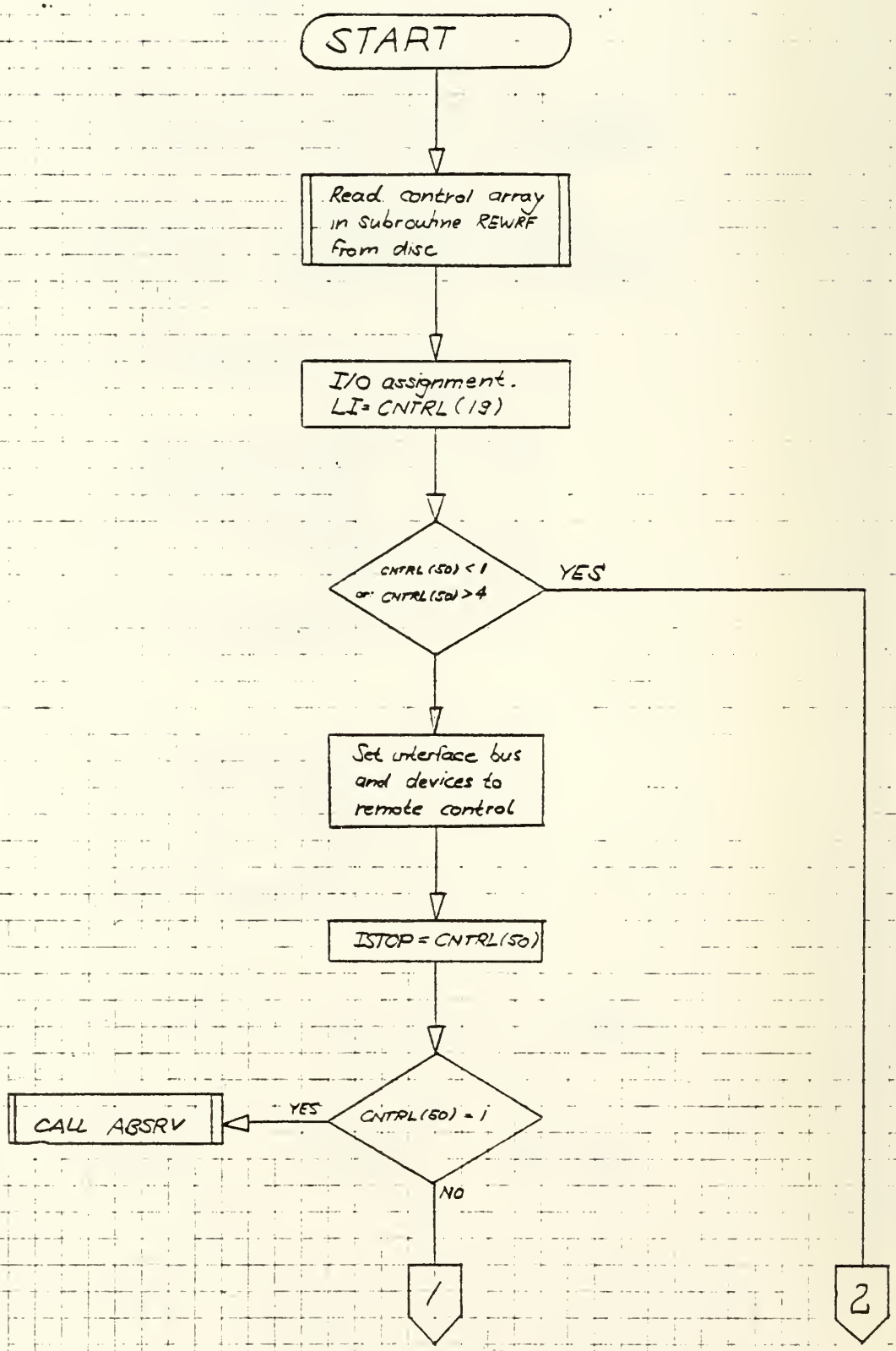


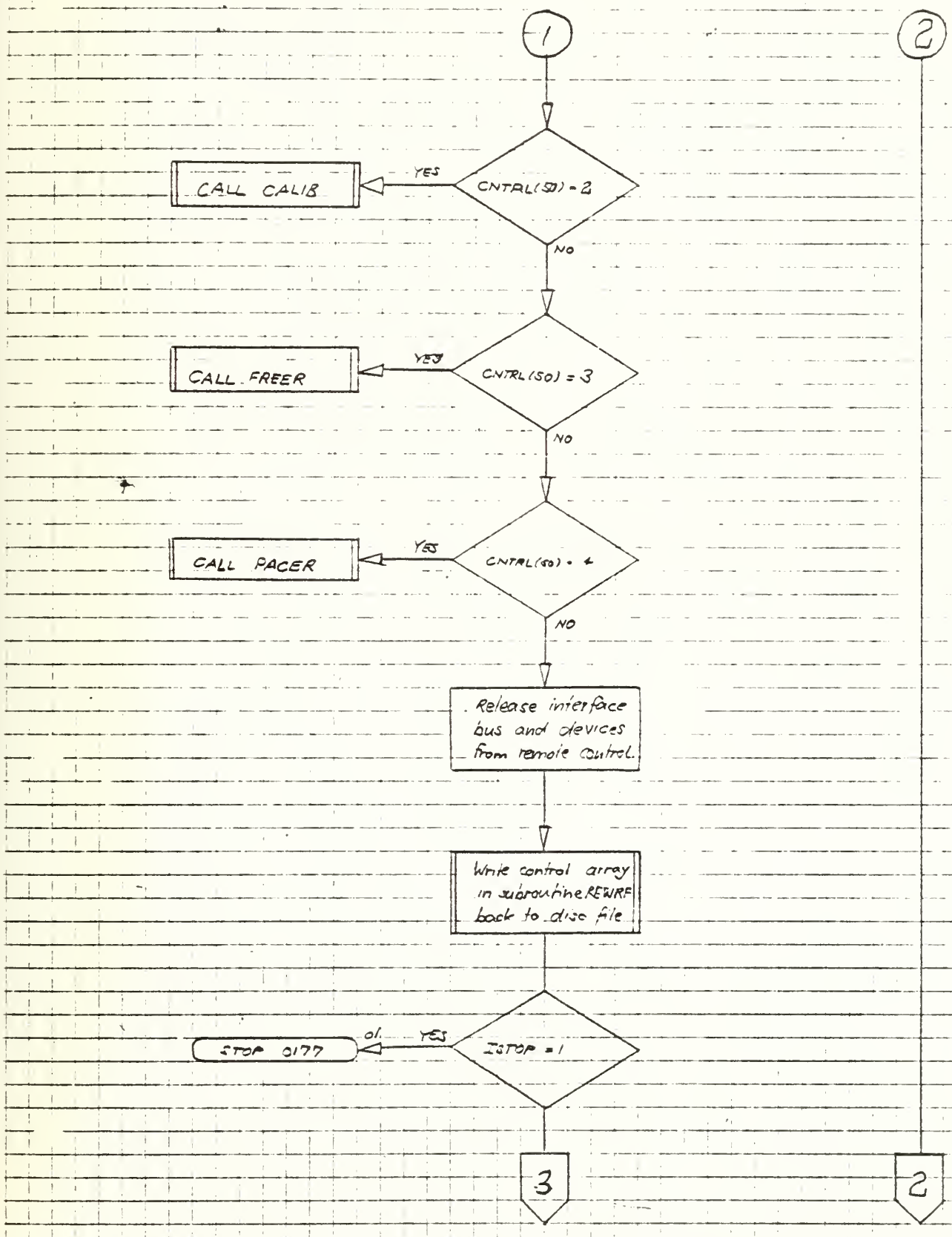


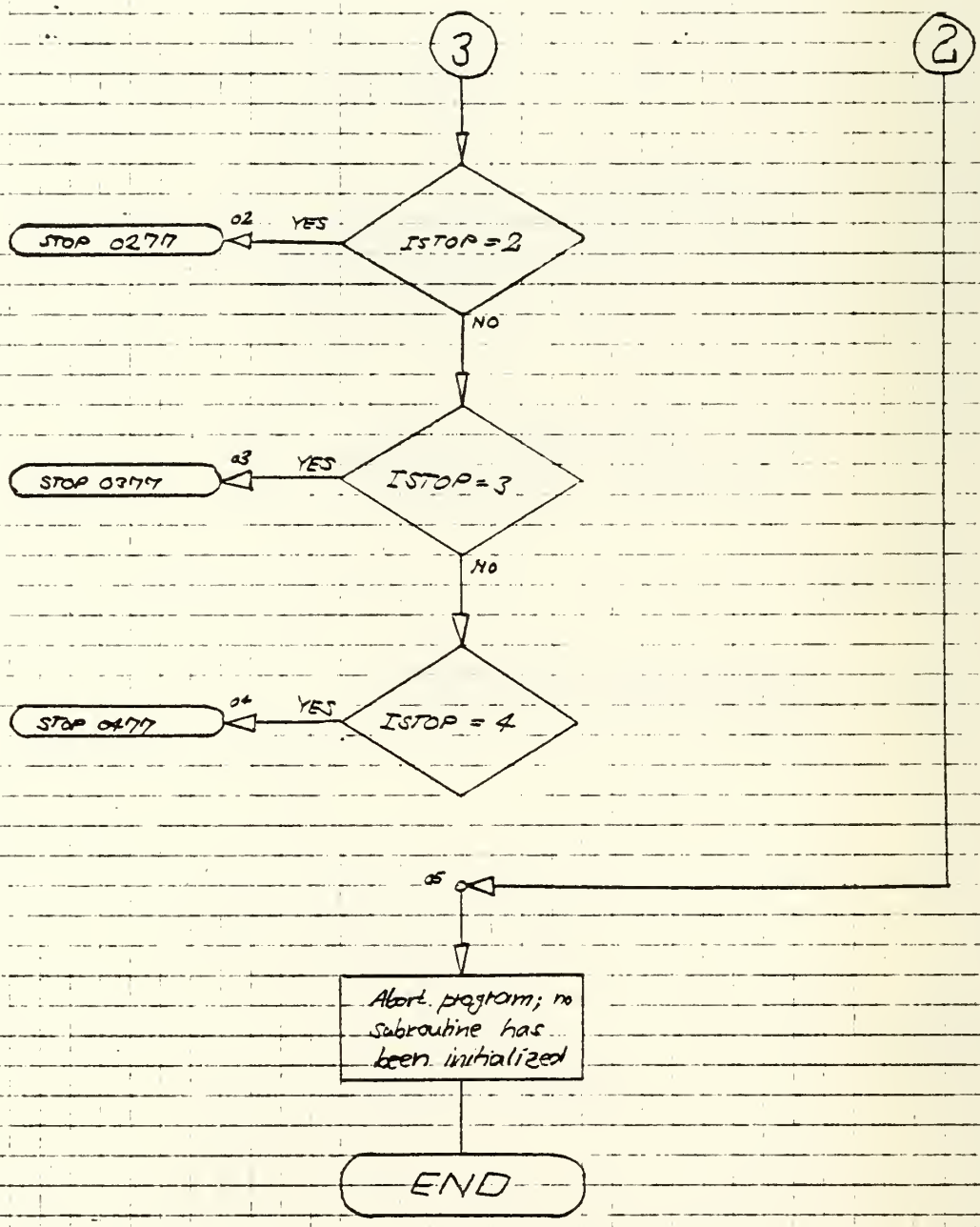
*) LU Assignments:

8	Scanner #1
10	Digital Voltmeter DVM
12	Counter
15	Scanner #2
7	HP-IB


2
3
CNTRL(50) = 1
... 2
... 3
... 4
CALL ABSRV
CALL CALIB
CALL FREER
CALL PACER
Release interface bus and devices from remote control.
CALL CLEAR (7,1)
CALL LOCL (7)
Write program control array back into disc file CNTRLF.
CALL REWRF
ISTOP = 1
... 2
... 3
... 4
01
02
03
04
STOP 0177
STOP 0277
STOP 0377
STOP 0477
05
Display error message.
END


START
Read control array in subroutine REWRF from disc
I/O assignment. LI = CNTRL(19)
CNTRL(50) < 1 or CNTRL(50) > 4
YES
Set interface bus and devices to remote control
ISTOP = CNTRL(50)
CNTRL(50) = 1
YES
CALL ABSRV
NO
1
2


1
2
CNTRL(50) = 2
YES
CALL CALIB
NO
CNTRL(50) = 3
YES
CALL FREER
NO
CNTRL(50) = 4
YES
CALL PACER
NO
Release interface bus and devices from remote control.
Write control array in subroutine REWRF back to disc file
ISTOP = 1
YES
01
STOP 0177
3
2


3
2
ISTOP = 2
YES
02
STOP 02777
NO
ISTOP = 3
YES
03
STOP 03777
NO
ISTOP = 4
YES
04
STOP 04777
05
Abort program; no subroutine has been initialized
END

4.2. SUBROUTINE ABSRV:

PURPOSE: Acquisition of high speed data from the 1-stage axial compressor using miniaturized probes equipped with KULITE semiconductor pressure transducers.

ARGUMENTS: None

EXTERNALS: CALIB, TIME, REAT, PURGE, OPEN, WRITE, POSNT, CLOSE, SCANR, PACER.

COMMON BLOCKS: CIBUF, CONTR, FMP. For detailed explanation refer to the TXC01 description.

MNENOMIC ABBREVIATIONS:

RE ... Repeat data acquisition of this yaw position.

NE ... Proceed to next yaw position.

EN ... End data acquisition at various yaw positions.

UP ... Update position readings of probes prior to data taking.

TA ... Initialisation command to take data.

PU ... Allow purge of an existing data file.

ERROR MESSAGES: If the number of yaw positions exceeds the previously defined number, the program terminates the sub-routine correctly (in order to save the already acquired data) and displays an error message (FORMAT 118). The total # of possible yaw positions is input prior to creating the raw data file, so that latter can be created at the desired length.

PROCEDURE: For more detailed information, study the flow chart. After having read the accounting data, assigned the I/O references and preset the raw data array, ABSRV asks the operator, whether the 'A'-'B'- probe system has been calibrated on line. If the answer is NO, ABSRV calls the subroutine CALIB, which controls the calibration. Then the calibration results are entered and the operator is asked to input the number of different yaw positions. Based on this information a raw data file of the appropriate length will be created and positioned. If the file with the automatically determined name already exists, the operator either allows overwriting the existing file (Input : PU) or renames the current data file (Input : any alphabetic character other than T). Prior to taking data the position of the probes is scanned and displayed. This control loop can be repeated by keying UP. Inputting TA initializes the data acquisition by subroutine PACER. Upon completion of the scan the operator can repeat this scan (Input : RE), proceed to the next point (Input : NE) with a different yaw position of both 'A' and 'B' probe. If the operator accidentally has decided to proceed to a probe position beyond the previously specified number, ABSRV displays an error message and terminates the subroutine correctly, i.e. saves the data in file, closes the file and writes the accounting data back into the control array.

DATA FILE: For more detailed information, study the following flow chart. The default file name is Tlrrss (rr ... ASCII converted run #, ss ... ASCII converted sequential #).

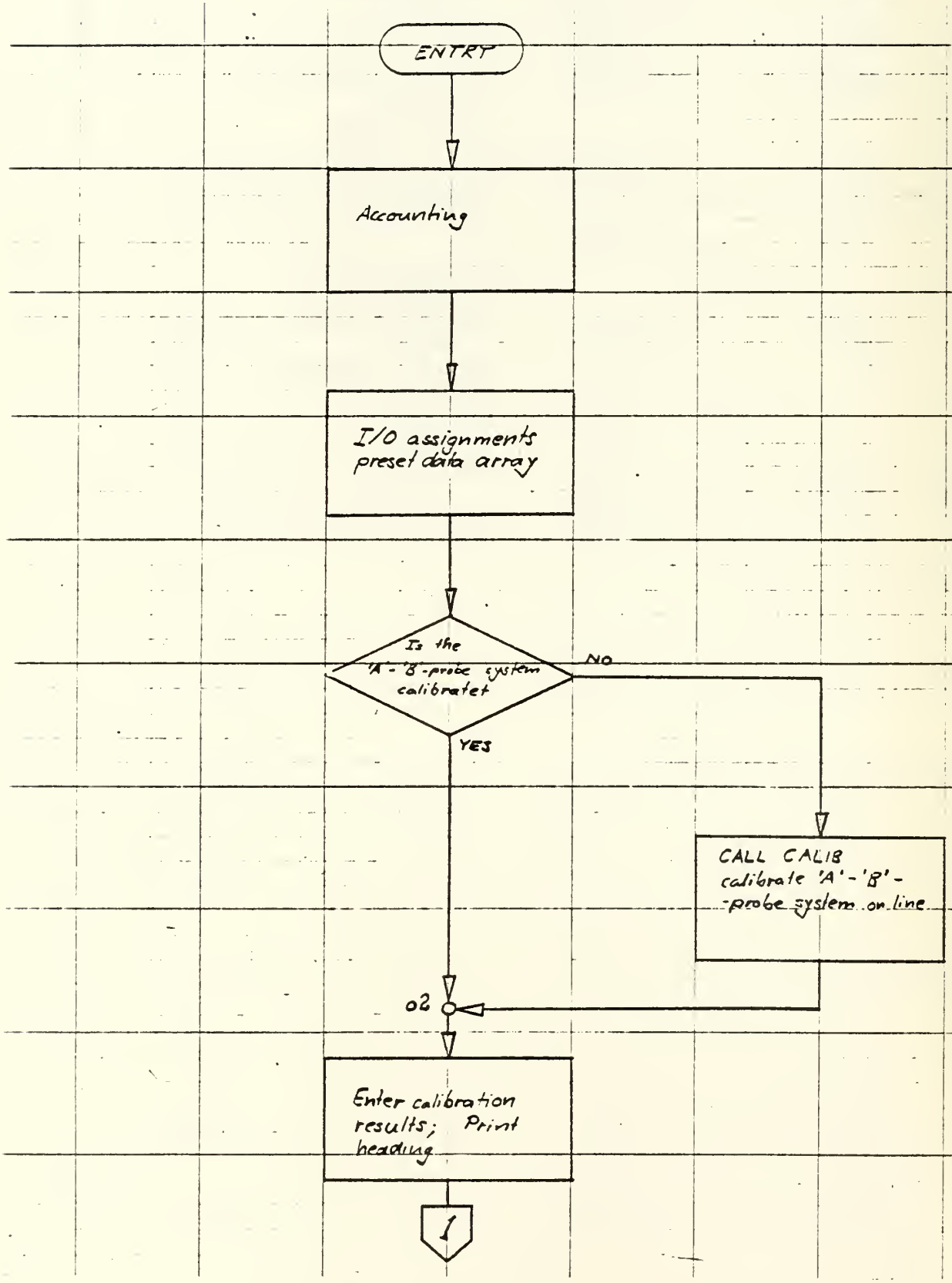
VARIABLES:

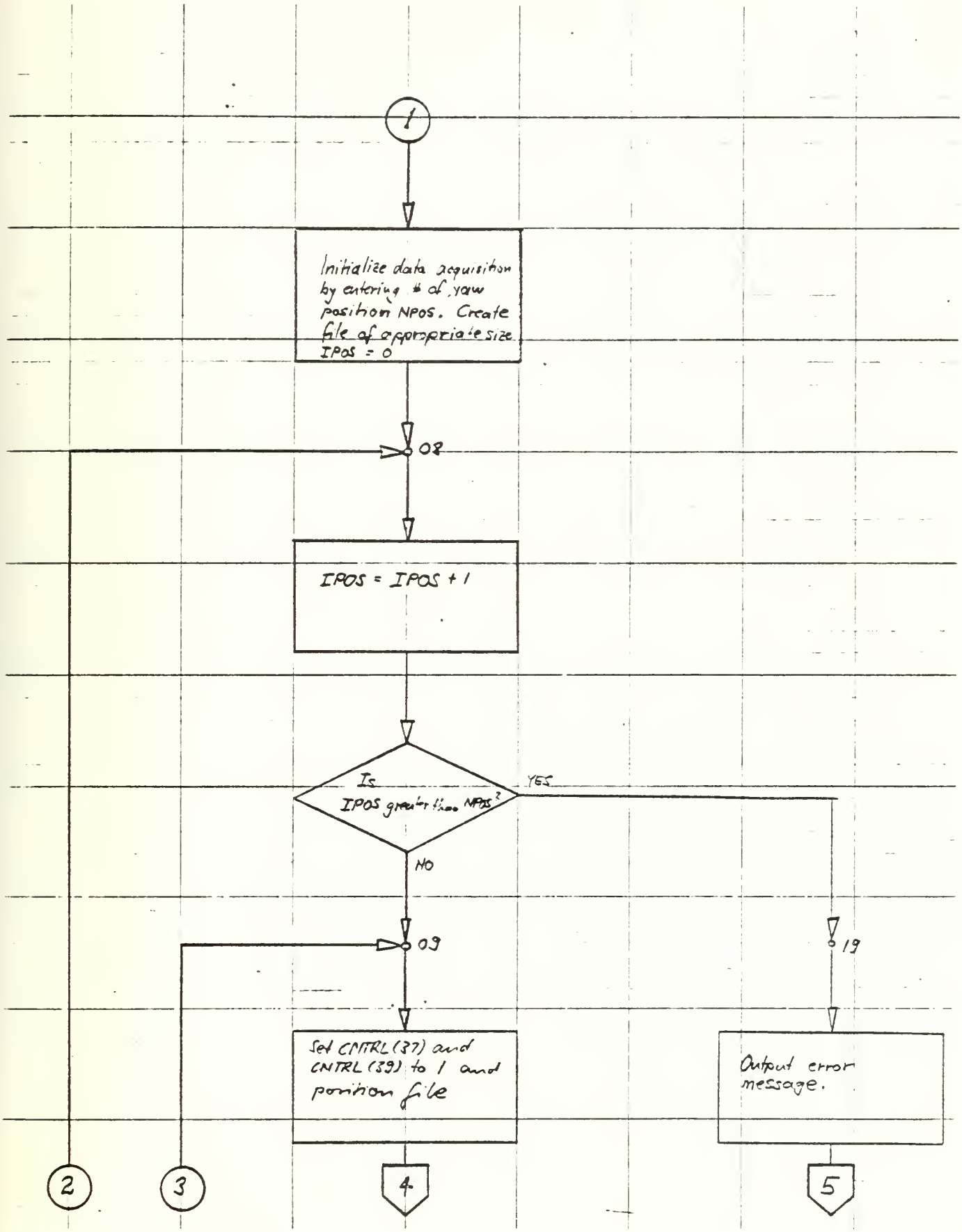
IBUF (1664)	integer	buffer array
CNTRL (256)	integer	control array
IDCB (144)	integer	data control block, used for FMP calls
IFILE (3)	integer	array to contain current file name calls
ISIZE (2)	integer	specifies # of records and record length
ISECU	integer	security code of data file
JSECU	integer	ASCll-converted security code
ICR	integer	cartridge reference number, when data file is located
JCR	integer	ASCII converted cartridge reference number
POS (7)	real	array to contain probe positions
RBUF (62)	real	data array, set equivalent to IBUF
NOLE	integer	suppresses line feed
NOCR (2)	integer	suppresses line feed and carriage return
ICLR (3)	integer	clear line above cursor
IDCBS	integer	length of data control block IDCB
IPAGE	integer	count of current page
IDOC	integer	count of current program run
IDOCF	integer	count of current data file sequential #
IL	integer	number of words to be transferred in FMP calls

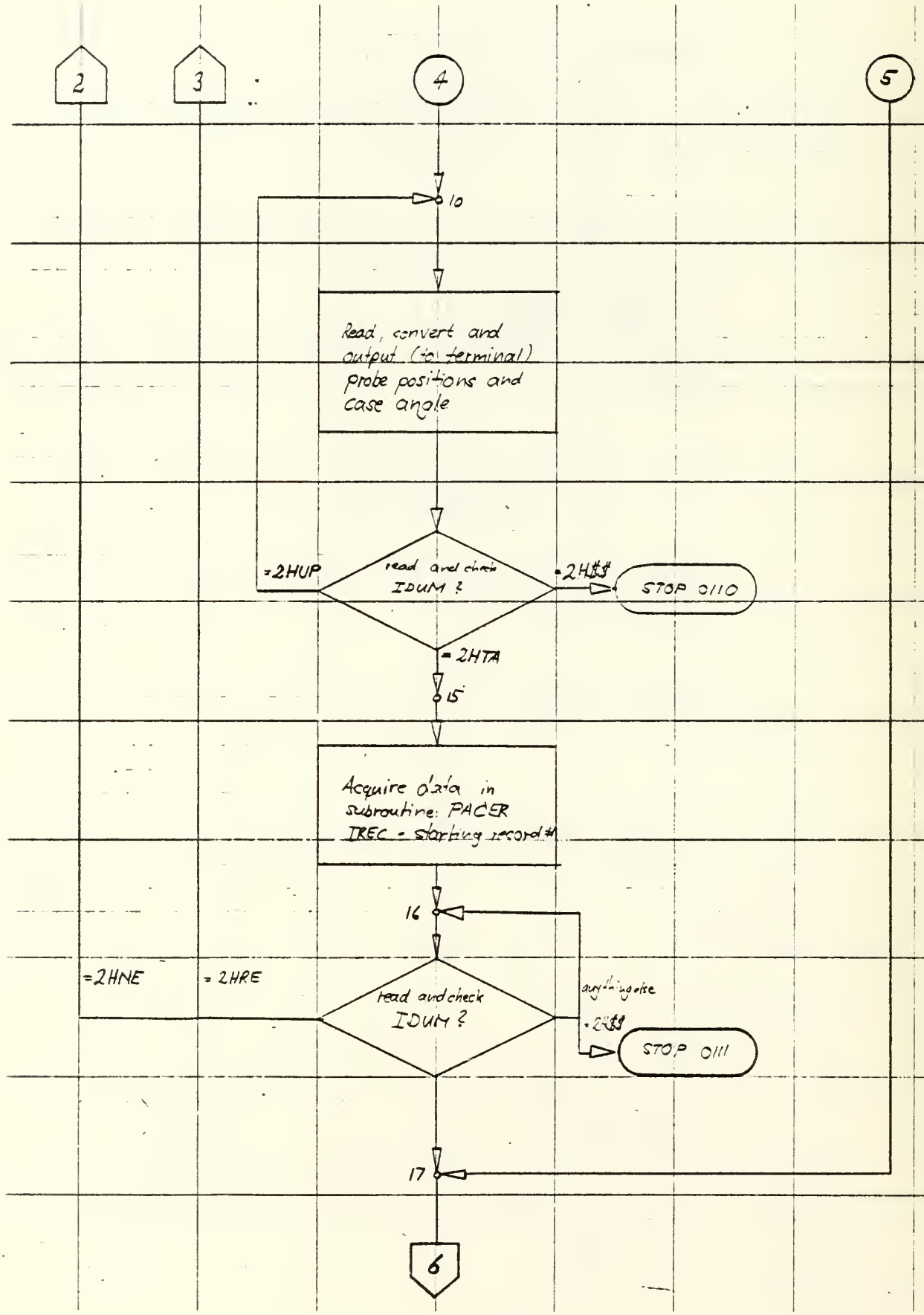
ITYPE	integer	type of data file
IFRST	integer	standard for the first two characters of file name
LI	integer	LU3 of standard input device (terminal)
LO	integer	LU# of standard output device (line position)
LS1	integer	LU# of scanner #1
LS2	integer	LU# of scanner #2
ICAL	integer	decision parameter
IDUM	integer	decision variable
SLOPEA	real	slope of linear curve fit for A probe calibration
SECONA	real	intercept of linear curve fit for A probe calibration
SLOPEB	real	slope of linear curve fit for B probe calibration
SECONB	real	intercept of linear curve fit for B probe calibration
AVRGEA	real	average voltage A probe, when aligned to flow
AVRGEB	real	average voltage B probe, when aligned to flow
PBARO	real	barometric pressure
NPOS	integer	number of different yaw positions 'A'-'B' survey
IERR	integer	error flag (FMP package)

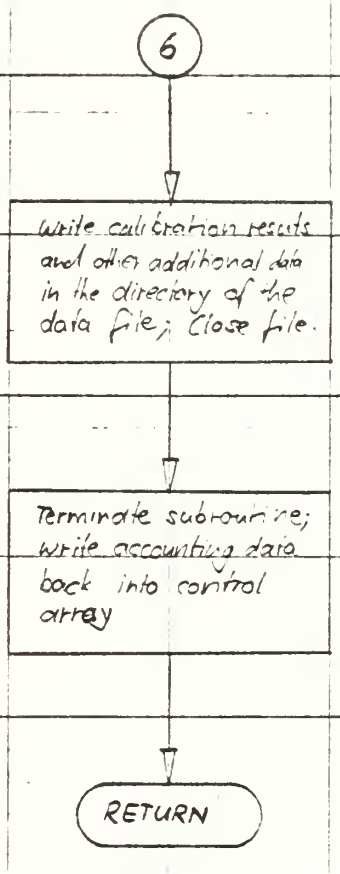
IMON	integer	ASCII converted month of the year
IDAY	integer	ASCII converted day of the month
IHOUR	integer	ASCII converted hour of the day (24 hr clock)
IMIN	integer	ASCII converted minute of the hour
IYEAR	integer	ASCII converted last two digits of current year
IFRST	integer	temporary buffer variable
NEW	integer	scratch variable for change of file name
IPOS	integer	current yaw position count
IREC	integer	record positioning variable

FLOW CHART SUBROUTINE ABSRV




1
Initialize data acquisition by entering # of yaw position NPOS. Create file of appropriate size. IPOS = 0
08
IPOS = IPOS + 1
Is IPOS greater than NPOS?
YES
NO
09
19
Set CNTRL(37) and CNTRL(39) to 1 and position file
Output error message.
2
3
4
5


2
3
4
5
10
Read, convert and output (to terminal) probe positions and case angle
=2HUP
read and check IDUM ?
≠2H$$
STOP 0110
=2HTA
15
Acquire data in subroutine: PACER
IREC = starting record #
16
=2HNE
=2HRE
read and check IDUM ?
anything else
≠2H$$
STOP 0111
17
6


6
Write calibration results and other additional data in the directory of the data file; Close file.
Terminate subroutine; write accounting data back into control array
RETURN

4.3. SUBROUTINE CALIB

PURPOSE: Control the on-line calibration for the A-B- probe system. This includes data acquisition and storage as well as approximating the calibration results.

ARGUMENTS: None

EXTERNALS: TIME, FREER, PACER, CURVE

COMMON BLOCKS: CONTR. For detailed explanation refer to the TXC01 description.

MNEMONIC ABBREVIATIONS:

RE ... Repeat this point

EN ... End the on-line probe calibrations

ERROR MESSAGES: If no calibration is performed, the subroutine outputs a warning (FORMAT 108) and terminates; this can happen, if at the first decision to be made the operator inputs EN.
If less than two points with different reference pressures are taken, the subroutine outputs an error message (FORMAT log) and terminates.
Both messages, if studied carefully, tell the operator how to avoid mistakes.

PROCEDURE: For more detailed information, study the flow chart. After having read the accounting data and assigned the I/O references, CALIB asks the operator to input a

number (which, when the program was debugged, was the digital multimeter read-out displaying the analog voltage of either 'A' or 'B' probe). This input initializes the data acquisition at the first reference pressure. Then the program reminds the operator to switch the pacer to free run mode. The operator responds by pressing the return key and the program calls subroutine FREER. Average voltage from both 'A' and 'B' probe, together with the KULITE reference pressure are written into the arrays AVOLT, BVOLT and RPRES, respectively. The operator then decides whether to repeat the measurements at this reference pressure (Input : RE), end the calibration (Input : EN) or proceed to the next point (Input : any numerical value). If the calibration is to be terminated, the operator is reminded to switch the pacer to paced run mode and, with the reference pressure unchanged, a paced scan is taken from both 'A' and 'B' probe (using PACER). Then subroutine CURVE computes an average linear curve fit through the data points (AVOLT vs. RPRES and BVOLT vs. RPRES respectively). In both cases slope and intercept are printed. Note, that the intercept is meaningless, but required in subroutine CURVE, which uses a least squares algorithm. CALIB then terminates and writes the accounting data back into the control array.

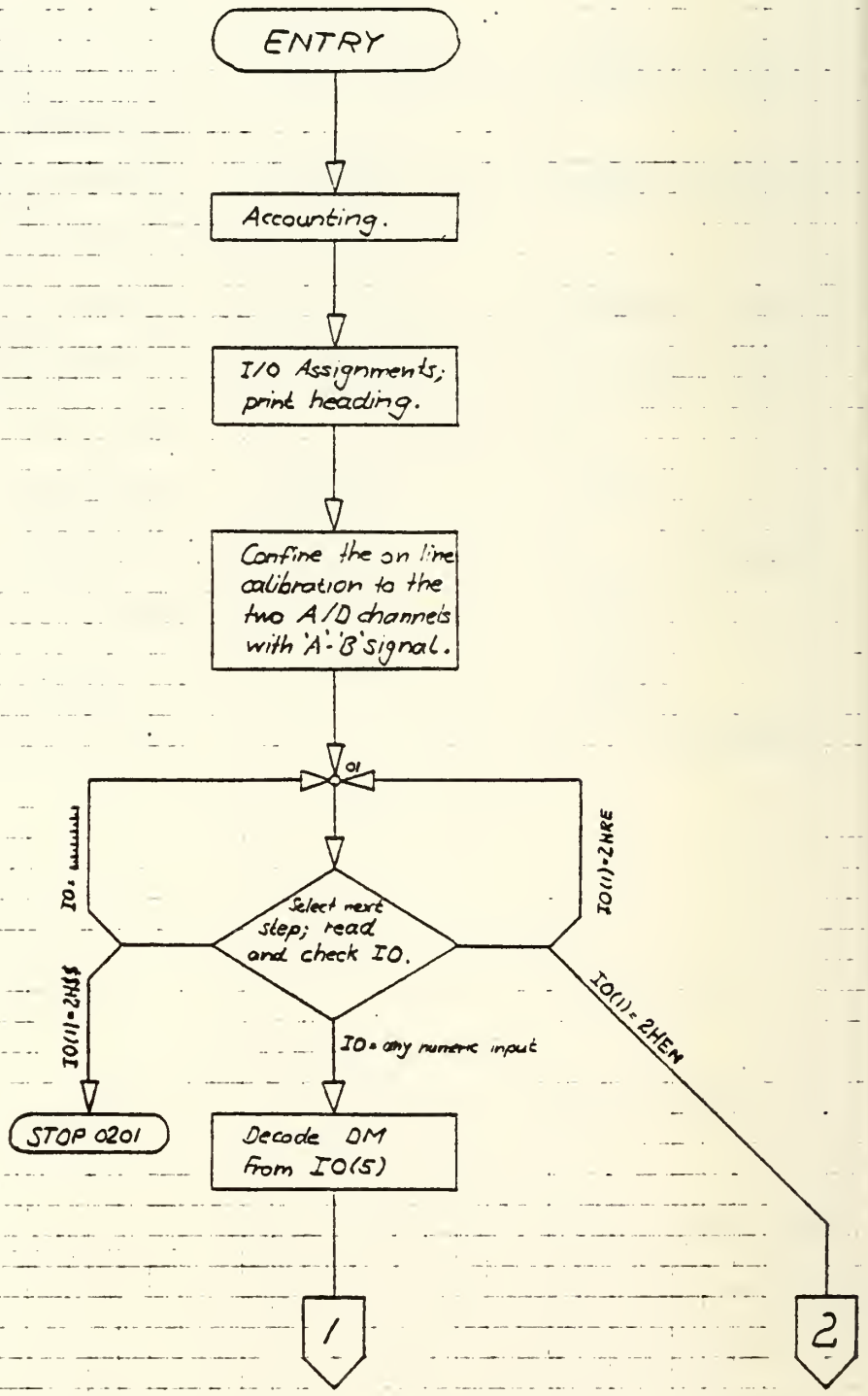
DATA FILE: Handled by subroutines FREER (Section 4.4) and PACER (Section 4.5).

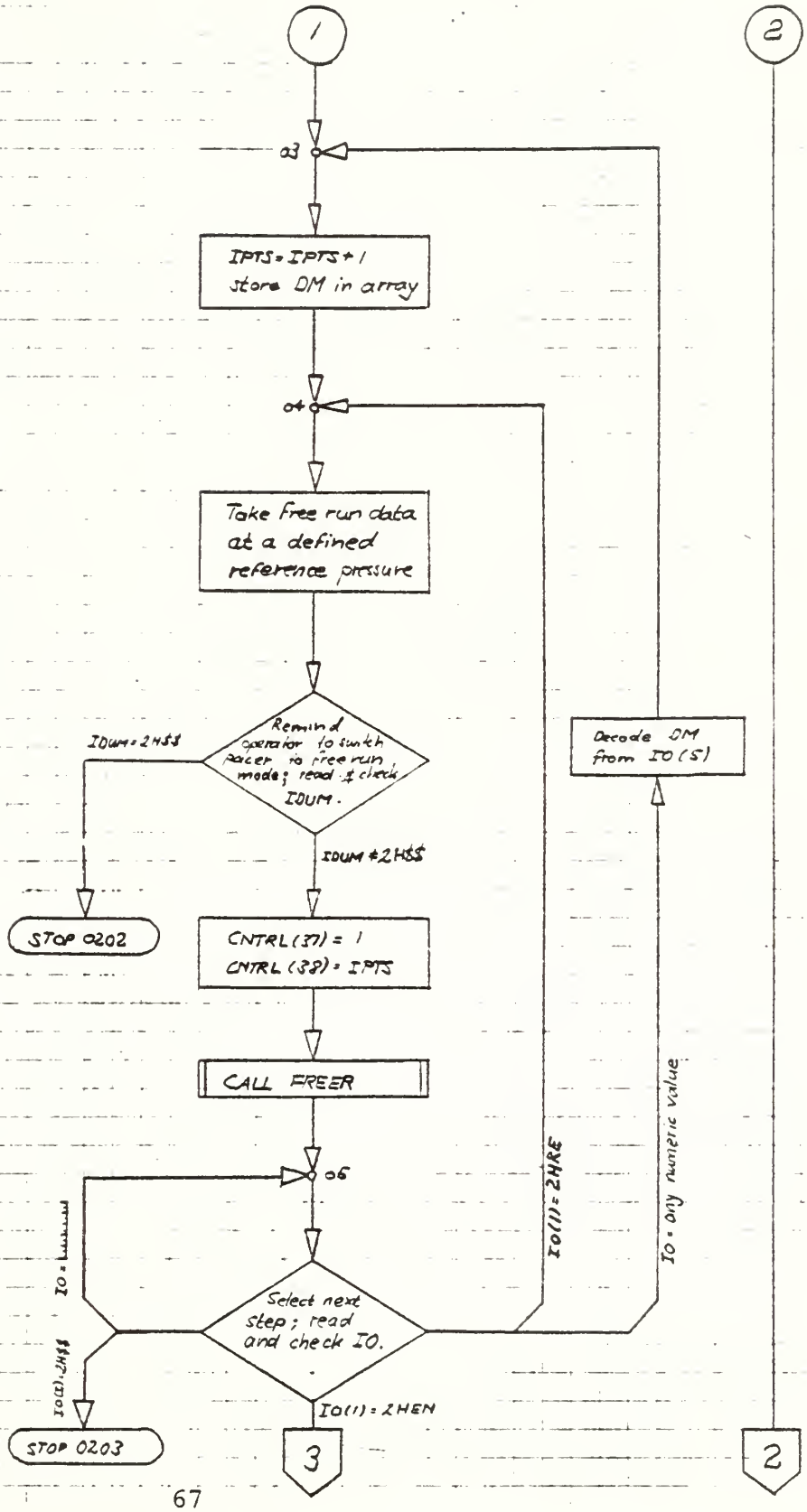
VARIABLES:

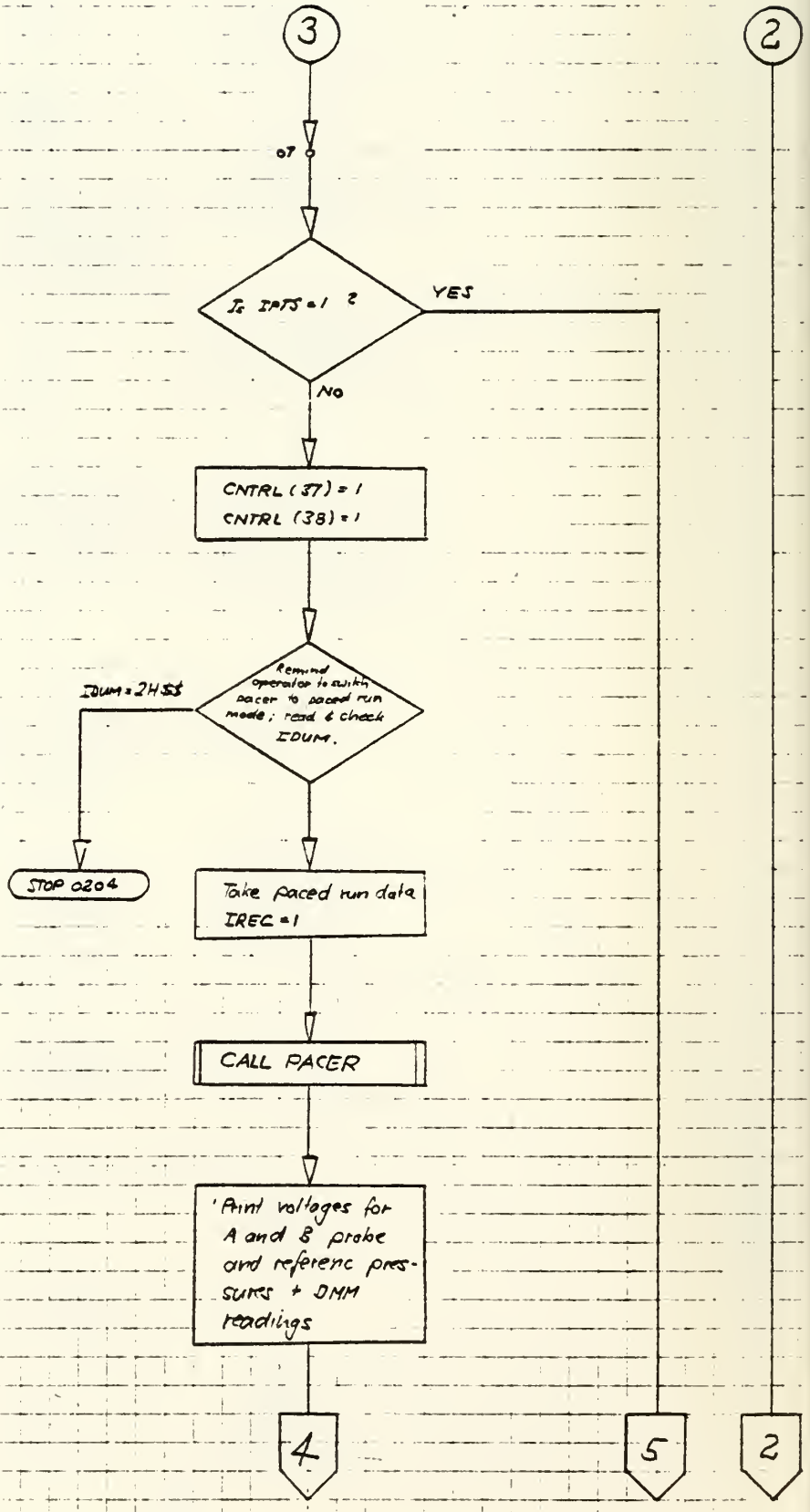
CNTRL (256)	integer	control array
AVOLT (10)	real	array to contain average voltages from A probe
BVOLT (10)	real	array to contain average voltages from B probe
RPRES (10)	real	array to contain reference pressures
DMM (10)	real	array to contain additional data (e.g.: DMM read outs)
NOLF	integer	suppresses line Feed
NOCR (2)	integer	suppresses line Feed and carriage return
ICLR (3)	integer	clears line above cursor
ITIME (5)	integer	array to contain ASCII converted date and time
IO (5)	integer	scratch array
IPAGE	integer	count of current page
LI	integer	LU# of standard input device (terminal)
LO	integer	LU# of standard output device (line printer)
IMON	integer	ASCII converted month of the year
IDAY	integer	ASCII converted day of the month
IYEAR	integer	ASCII converted last two digits
IHOUR	integer	ASCII converted hour of the day (24 hr clock)

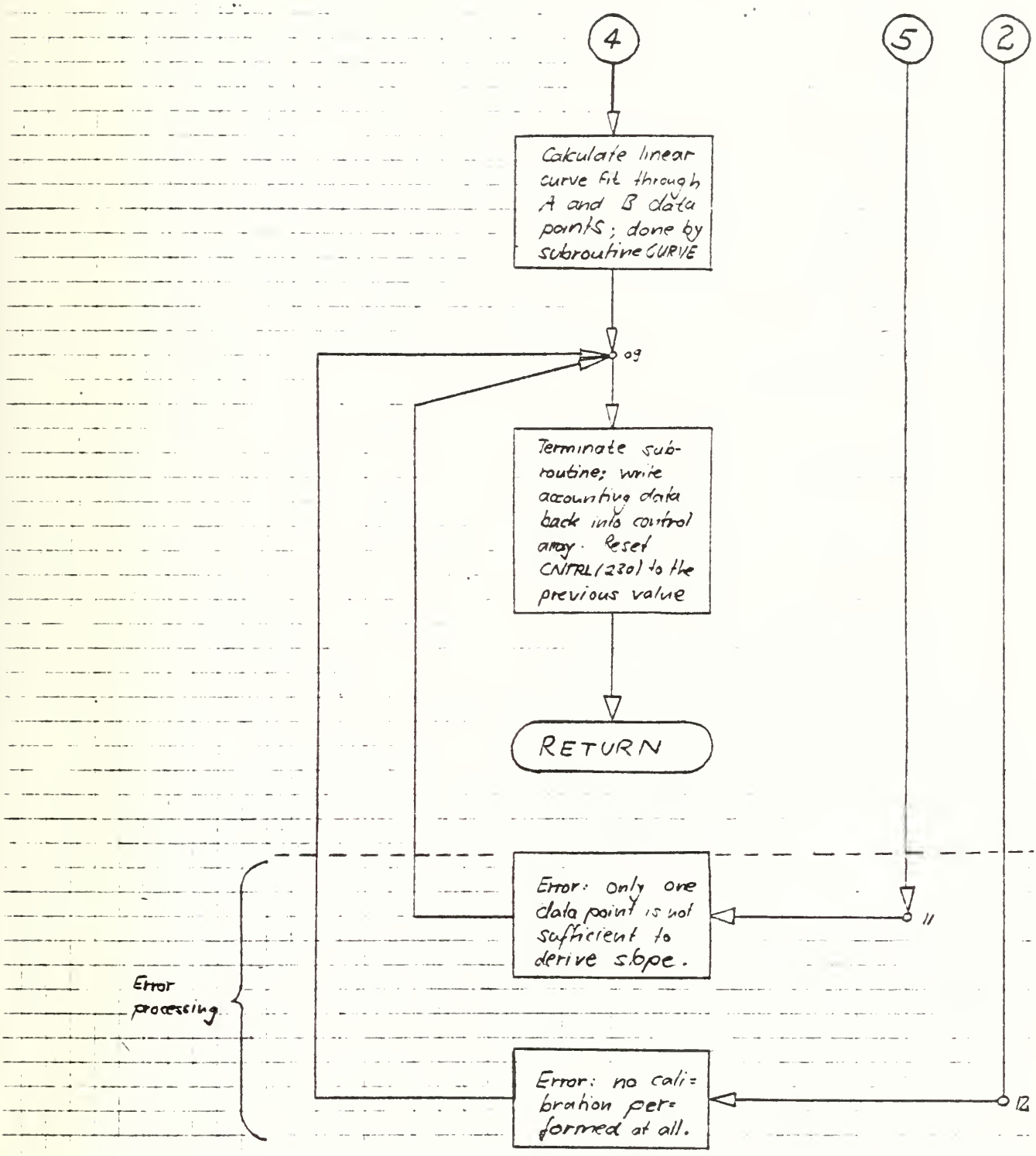
IMIN	integer	ASCII converted minute of the hour
IPTS	integer	variable count total # of calibration positions
IPREV	integer	variable temporary stores contents of CNTRL (219)
IDUM	integer	scratch variable
DM	real	variable used to decode value from array IO
IREC	integer	starting record for paced run-data array
SLOPE	real	slope of linear curve fits
SECON	real	intercept of linear curve fit (as from CURVE)

FLOW CHART SUBROUTINE CALIB




1
2
23
IPTS = IPTS + 1
store DM in array
04
Take free run data at a defined reference pressure
Remind operator to switch pacer to free run mode; read & check IDUM.
IDUM = 2H$$
IDUM ≠ 2H$$
STOP 0202
CNTRL(37) = 1
CNTRL(38) = IPTS
CALL FREER
06
Select next step; read and check IO.
IO = bbbbbb
IO(1) = 2H$$
STOP 0203
IO(1) = 2HEN
3
IO(1) = 2HRE
Decode DM from IO(5)
IO = any numeric value
2


3
2
07
Is IPTS = 1 ?
YES
NO
CNTRL (37) = 1
CNTRL (38) = 1
Remind operator to switch pacer to paced run mode; read & check IDUM.
IDUM = 2HSS
STOP 0204
Take paced run data
IREC = 1
CALL PACER
'Print voltages for A and B probe and reference pressures + DMM readings
4
5
2


4
5
2
Calculate linear curve fit through A and B data points; done by subroutine CURVE
09
Terminate subroutine; write accounting data back into control array. Reset CNTRL(230) to the previous value
RETURN
Error: only one data point is not sufficient to derive slope.
11
Error processing
Error: no calibration performed at all.
12

4.4. SUBROUTINE FREER:

PURPOSE: Control data acquisition from HP 5610 A/D converter, store data in file and documentation, perform calculation of average voltage.

ARGUMENTS: AVOLT, BVOLT, PREFR

AVOLT	real	average voltage from 'A'- probe, based on NRPT3 points
BVOLT	real	average voltage from 'B'- probe, based on NRPT3 points
PREFR	real	reference pressure for KULITE transducers (raw data format)

EXTERNALS: TIME, ICON, SCANR, EXEC, ABREG, CREAT, OPEN, PURGE, WRITF, CLOSE

COMMON BLOCKS: CIBUF, CONTR, FMP. For detailed description refer to the TXCOl description

MNEMONIC ABBREVIATIONS:

PU ... Allow purge of an existing data file

ERROR MESSAGES: If the EXEC call to read the voltages from the A/D converter is not executed correctly, an error return occurs as follows:

```
                                  ┌──────▷ set the no-abort bit.
                                  ┌──────┐
      CALL EXEC (1 + 100000B, 20, IBUF(1), NRPT2, ICHNL, 4)
      GO TO 11 ◁── error return:  perform error processing!
10    GO TO 12 ◁── good return:  proceed!
11    CALL ABREG (IA,IB) ◁── look, what's in the registers.
      GO TO 21
      .
      .
      .
c
c
c     Error returns ....
c
c

21    WRITE (6, 901) NRPT2, ICHNL      ┐
      WRITE (6, 902) IA, IB            ┘ ──▷ output error message,
      GO TO 20                               then terminate
                                             subroutine
```

PROCEDURE: For more detailed information, study the flow chart. The subroutine reads the accounting data from the control array and defines FMP parameters (FMP : File Management Package, manipulates disc Files). Next the I/O references are assigned and all words of the raw data array are preset to be 177777B. If CNTRL (37) is set to 1, the heading for the Free Run documentation page is printed. If CNTRL (38) is set to one, a key to the printout is printed. Then the data acquisition loop starts and executes NRPT1 times (NRPT1 = CNTRL (230) = number of KULITE signals to be acquired; maximum is 16). Should the sequential number for the data file name become greater than 99, the first two characters of the file name are changed from T2 (default) to S2 and the count is reset to zero. Additional data is acquired and the probe positions are read and written into the variable IOX1M. Prior to the data acquisition all unused elements of the data array are set to zero. Utilizing the EXEC call NRP2 measurements are performed and the A/D digital

output is written into array IBUF, starting at address of word IBUF (1). ICHNL specifies the selected A/D analog input channel. The 4 in the parameter list causes the A/D converter to dump data into the CPU as fast as possible via DMA (Direct Memory Access). If an error occurs, its reason is enquired (see preceding segment ERROR MESSAGES). To calculate the average voltage, all words of IBUF must be anded with IMASK, because bits 0 through 5 are used to control the data transfer.

```
          bit  15   12     9     6     3     0
IBUF(J2)       1 1 1 1 0 0 1 0 1 1 1 0 0 0 1 0  =  171342B
IMASK          1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0  =  177700B = -64
IBUF(J2) = IAND (IBUF(J2), IMASK)
IBUF(J2) =     1 1 1 1 0 0 1 0 1 1 0 0 0 0 0 0  =  171300B = -3392
```

To derive the voltage, IBUF(J2) must first be divided by the maximum value which can be transferred by a 16-bit word when the bits 0 through 5 do not contain data; this word is

```
               0 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0  =  077700B = 32704
```

This bit configuration corresponds to the full scale voltage (FSVLT) of +1 Volt. When no bit is set, the voltage is 0 (ensured by calibration). Thus if the integer, IBUF(J2) is divided by 32 704 and multiplied by unity the voltage is obtained. Since the bits 0 through 5 are not used for data, the maximum voltage resolution of the A/D converter is

$$R = \frac{100B}{77700B} * FSVLT = \frac{64}{32\ 704} * FSVLT = \frac{1}{511} * FSVLT$$

$$R = .001\ 956\ 947 \text{ Volt, if } FSVLT = +1.0 \text{ V}$$

The voltage associated with the bit configuration

1 1 1 1 0 0 1 0 1 1 0 0 0 0 0 0 = 171300B = -3392

is -.103 718 Volt = $\frac{-3\ 392}{32\ 704}$ * 1.0 Volt. In the Subroutine, however, the division through 32 704 and the multiplication with FSVLT is executed after all the voltages from NRPT2 points are added in order to compute the average voltage. The average voltage then is written into the variable AVOLT or BVOLT, depending on which probe has been selected. The data then are saved in a file. If a file with the automatically determined name already exists, the operator either allows overwriting the existing file (Input : PU) or renames the current data file (Input : any alphabetic character other than T). This is the only interactive manipulation in the subroutine. The data acquisition loop terminates, printing the most important data. Accounting data are written back into the control array and the subroutine returns control to the calling program.

DATA FILE: The data file consist of 13 records with a length of 128 words each, so that 1664 = (128 * 13) words can be stored. The default file name is T2rrss (rr ... ASCII converted run #, ss ... ASCII converted sequential #).

VARIABLES:

IBUF (1664)	integer	buffer array for raw data
CNTRL (256)	integer	control array
IDCB (144)	integer	data control block, used for FMB calls

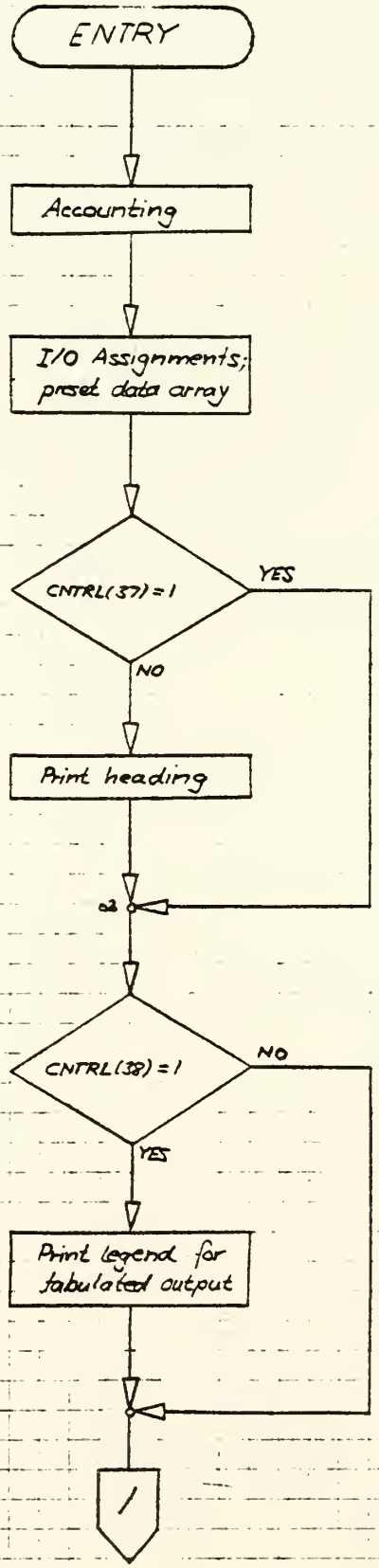
IFILE (3)	integer	array to contain current file name
ISIZE (2)	integer	specifies # of records and record length
ISECU	integer	security code of data file
ICR	integer	cartridge reference number, where data file is located
NOLF	integer	suppresses line feed
NOCR (2)	integer	suppresses line feed and carriage return
ICLR (3)	integer	clear line above cursor
IOXIM (9)	integer	array, where 'A' and 'B' probe positions are written into in ASCII code
FSVLT	real	full scale voltage of A/D converter
IDCBS	integer	length of data control block IDCB
IPAGE	integer	counts of current page
IDOC	integer	counts, how often this subroutine is called
IDOCF	integer	count of current data file sequential #
ITYPE	integer	type of data file
IFRST	integer	standard for the first two characters of file name
ISP	integer	decision variable, used to space the output

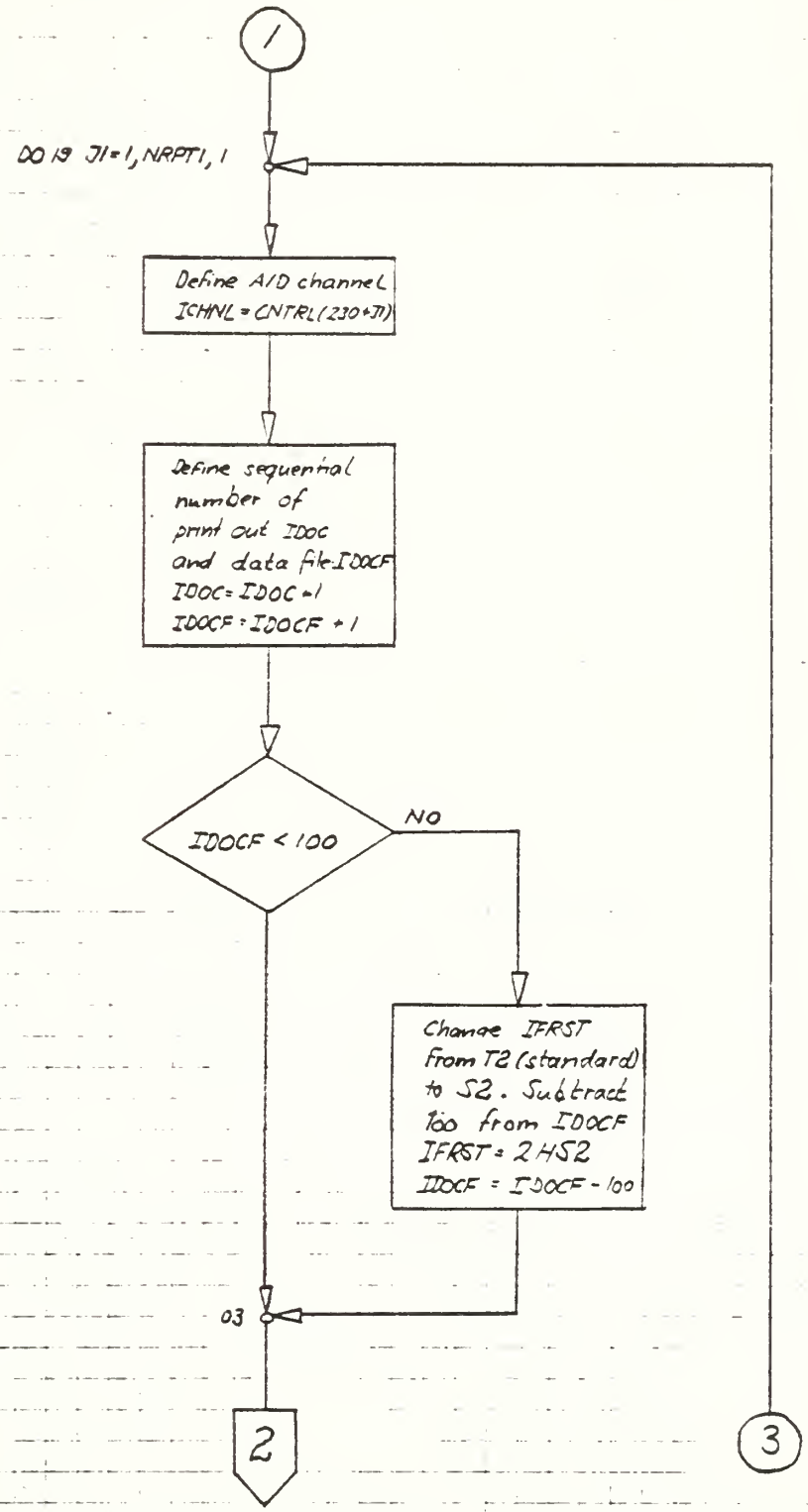
IL	integer	number of words to be transferred in FMP calls
LI	integer	LU# of standard input device (terminal)
LO	integer	LU# of standard output device (line printer)
LS1	integer	LU# of scanner #1
LS2	integer	LU# of scanner #2
ISV1	integer	code # of S/V controller #1
ISV4	integer	code # of S/V controller #2
NRPT1	integer	# of various KULITE signals to be acquired
NRPT2	integer	total # of point, taken from each KULITE signal
NRPT3	integer	= NRPT2+ : DO loop start address
IMASK	integer	masking variable
IW	integer	controls time delay between closing S/V port and reading voltage
IMON	integer	ASCII converted month of the year
IDAY	integer	ASCII converted day of the month
IHOUR	integer	ASCII converted hour of the day (24 hr clock)
IMIN	integer	ASCII converted minute of the hour
IYEAR	integer	ASCII converted last two digits of current year
ICHNL	integer	A/D input channel to be selected
FREQ	real	RPM of the transonic compressor

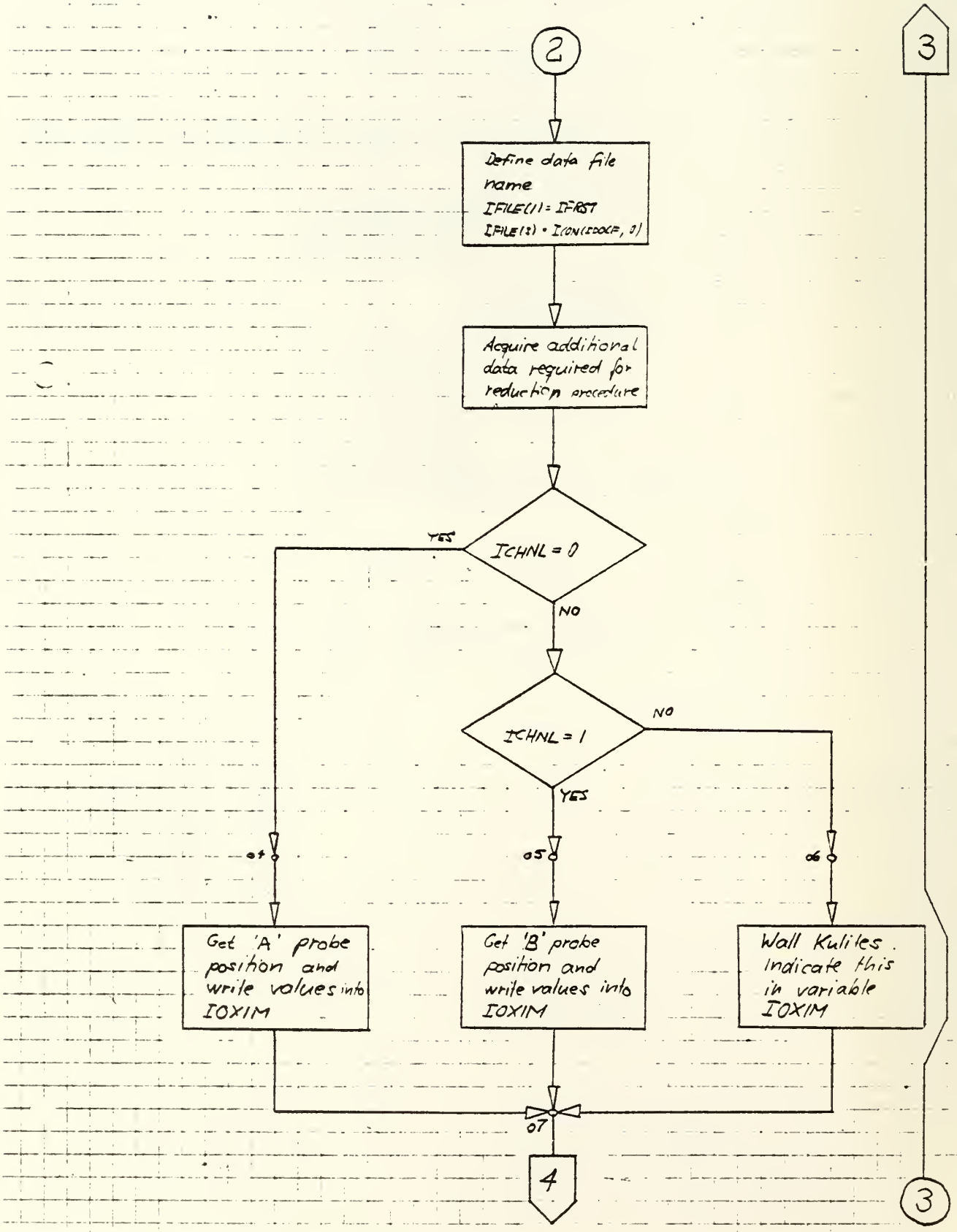
CIM	real	immersion of the combination probe
CYAW	real	yaw angle of the combination probe
PREF	real	KULITE reference pressure
PREFR	real	KULITE reference pressure as returned to the calling routine (either CALIB, ABSRV or TXCOl)
P1	real	pressures P_1, P_{23} & P_4 from calibration probe
P23	real	
P4	real	
E	real	Temperature reading from sensor ahead of rotor (in mV)
DE	real	Differential temperature reading from station ahead of rotor across rotor
XIM	real	Immersion of the KULITE probe
YAW	real	Yaw angle of the KULITE probe
IA	integer	Variable to contain contents of A register
IB	integer	Variable to contain contents of B register
AVRGE	real	KULITE output average voltage after amplification and A/D conversion
AVOLT	real	'A' probe output average voltage
BVOLT	real	'B' probe output average voltage
ISP	integer	control variable to space output
IDUM	integer	decision variable

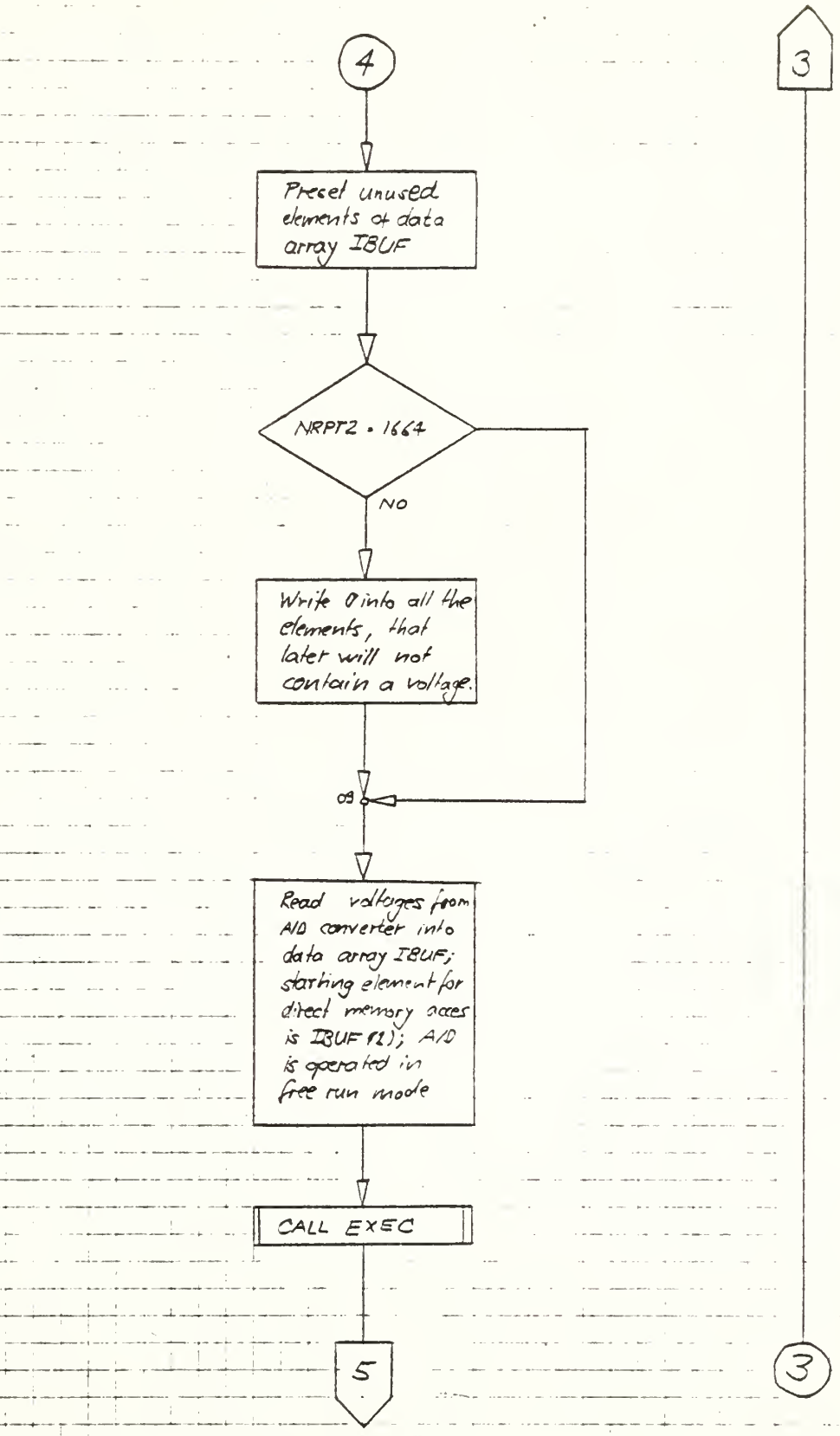
IERR	integer	error flag returned from FMP calls
JSECU	integer	ASCII converted security code
JCR	integer	ASCII converted cartridge reference number
NEW	integer	variable to contain changed first two characters of raw data file name

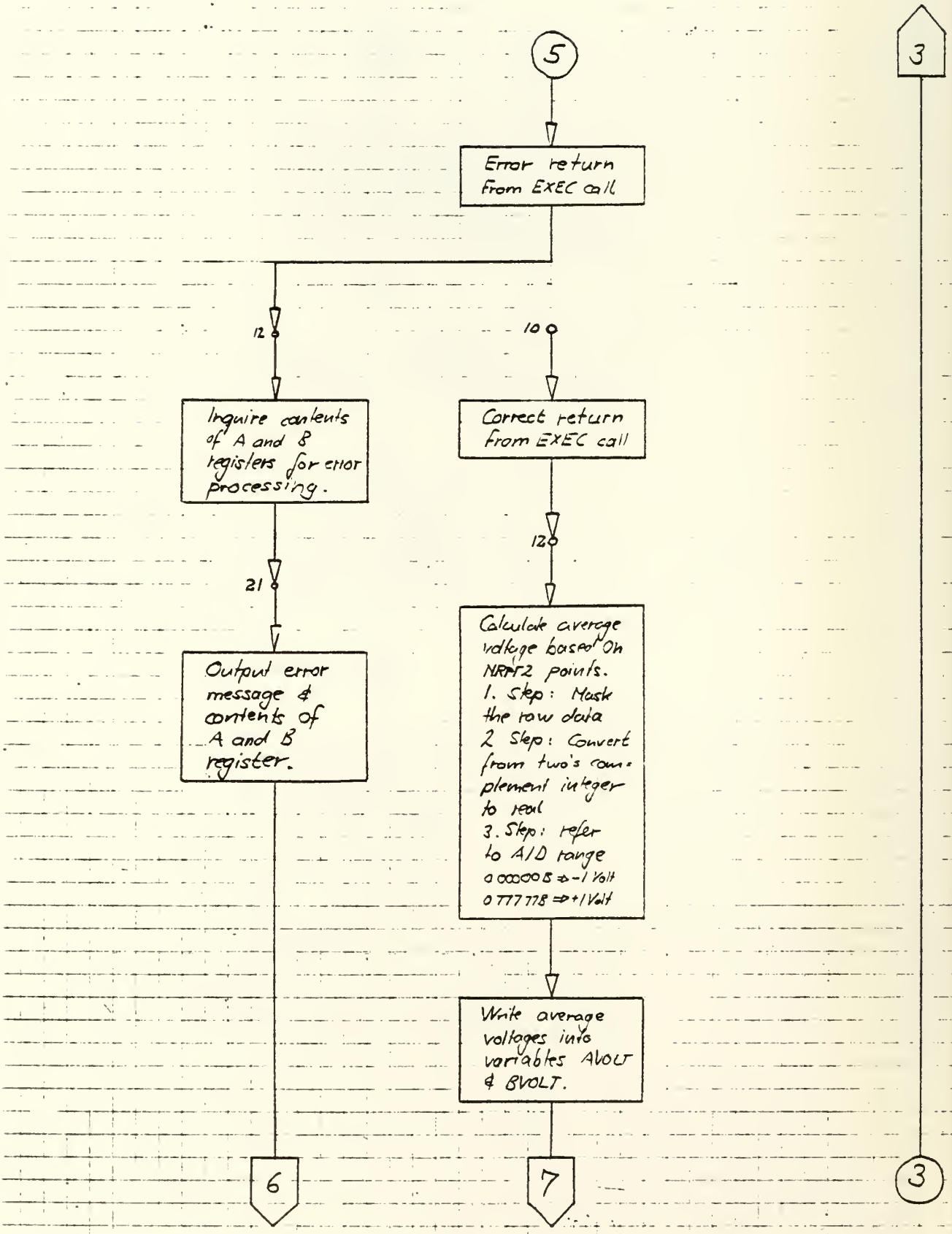
FLOW CHART SUBROUTINE FREER

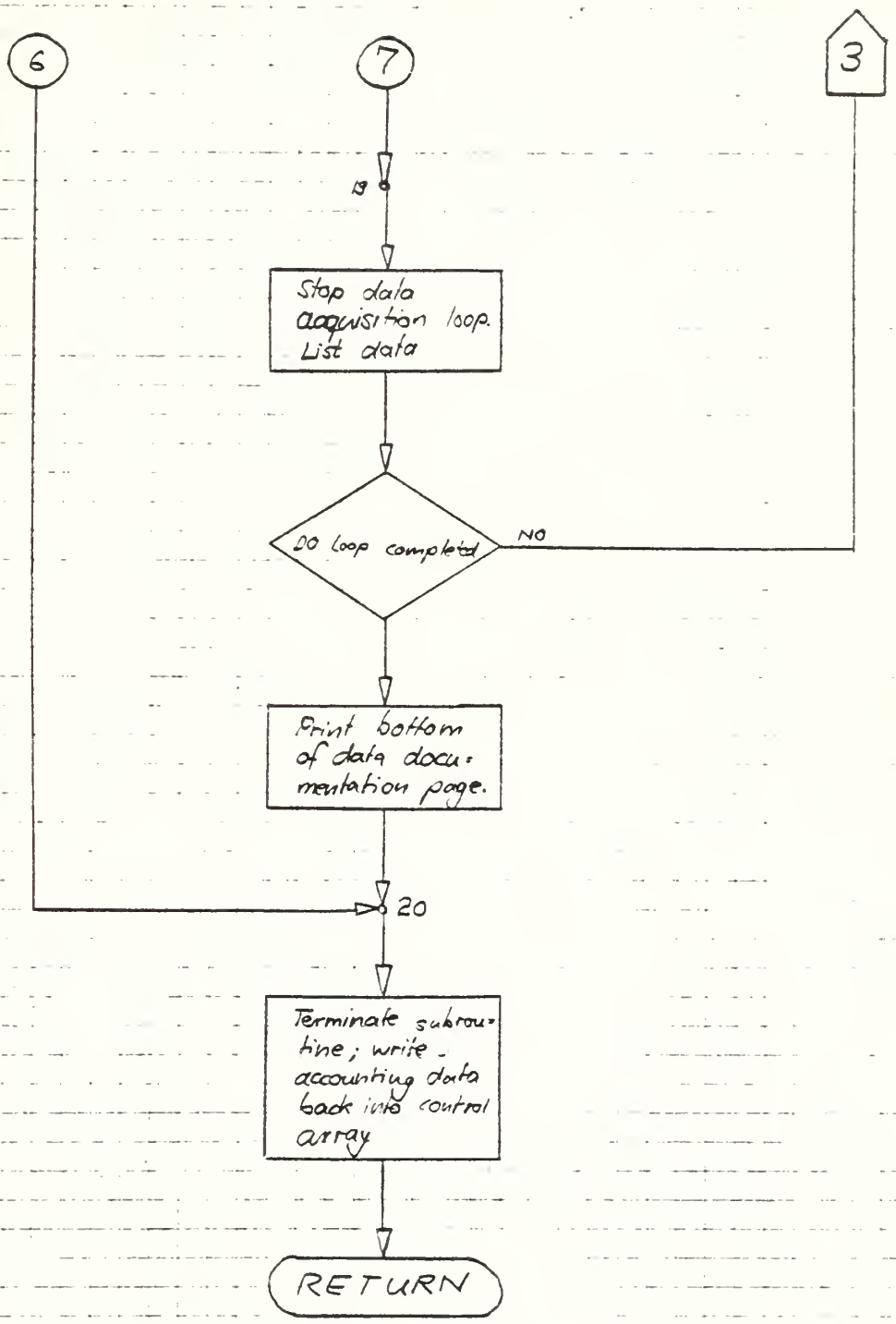



1
DO 19 JI=1,NRPTI,1
Define A/D channel
ICHNL=CNTRL(230+JI)
Define sequential
number of
print out IDOC
and data file IDOCF
IDOC=IDOC+1
IDOCF=IDOCF+1
IDOCF < 100
NO
Change IFRST
from T2 (standard)
to S2. Subtract
100 from IDOCF
IFRST=2HS2
IDOCF=IDOCF-100
03
2
3


2
3
Define data file name
IFILE(1) = IFIRST
IFILE(2) = ICONCODE(F, 0)
Acquire additional data required for reduction procedure
ICHNL = 0
YES
NO
ICHNL = 1
NO
YES
04
05
06
Get 'A' probe position and write values into IOXIM
Get 'B' probe position and write values into IOXIM
Wall Kuliles. Indicate this in variable IOXIM
07
4
3


4
3
Preset unused elements of data array IBUF
NRPT2 • 1664
NO
Write 0 into all the elements, that later will not contain a voltage.
09
Read voltages from A/D converter into data array IBUF; starting element for direct memory acces is IBUF(1); A/D is operated in free run mode
CALL EXEC
5
3


5
Error return from EXEC call
12
10
Inquire contents of A and B registers for error processing.
Correct return from EXEC call
21
120
Output error message & contents of A and B register.
Calculate average voltage based on NRPT2 points.
1. Step: Mask the raw data
2 Step: Convert from two's complement integer to real
3. Step: refer to A/D range
0 000000B ⇒ -1 Volt
0 777777B ⇒ +1 Volt
Write average voltages into variables AVOLT & BVOLT.
6
7
3
3


6
7
3
19
Stop data acquisition loop. List data
DO loop completed
NO
Print bottom of data documentation page.
20
Terminate subroutine; write accounting data back into control array
RETURN

4.5. SUBROUTINE PACER:

PURPOSE: Control data acquisition from HP 5640 A/D converter if this device is triggered by the pacer, store data in file and document all steps.

ARGUMENTS: IREC

IREC integer starting record #, where raw KULITE and additional data are written

EXTERNALS: TIME, ICON, SCANR, ACQN, RPACE, PICTR, CREAT, OPEN, PURGE, WRITF, CLOSE

COMMON BLOCKS: CIBUF, CONTR, FMP. For detailed description refer to the TXCO1 description.

MNEMONIC ABBREVIATIONS:

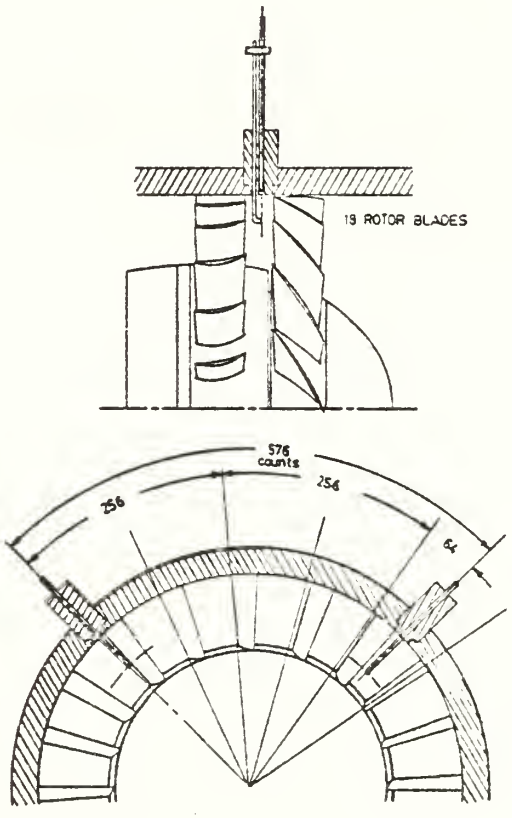
PU ... Allow purge of an existing data file

RE ... Repeat data acquisition

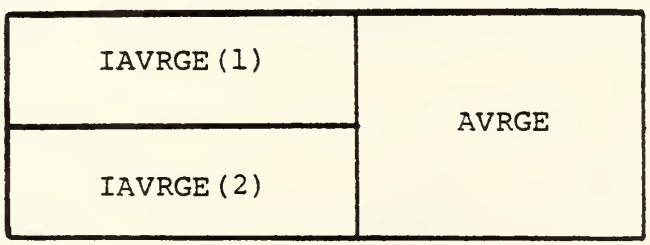
ERROR MESSAGES: None

PROCEDURE: For more detailed information, study the flow chart! The subroutine reads the accounting data from the control array and defines FMP parameters (FMP: file management package, manipulates disc files; refer to the HP manuals for more information). Next the I/O references are assigned and the words of the data array are present. If CNTRL (37) is set to 1, the heading for the paced run documentation page is printed. If CNTRL (38) is set to 1, a key to the print

out is printed. Then the data acquisition loop starts and executes NRPT1 times (NRPT1 = CNTRL (230) = number of KULITE signals to be acquired; maximum is 16). If CNTRL (39) is set to 1 (i.e.: subroutine PACER is called from subroutine ABSRV, which takes care of creating/opening, positioning and closing files), the accounting of the data file names is skipped. If otherwise, i.e. CNTRL (39) is not equal to 1, the sequential number for the data file name exceeds 99, the first two characters of the file name are changed from T3 (default) to S3 and the count is reset to zero. Additional data is acquired and the probe positions are read and written into the variable IOX1M. Since the KULITE probes are mounted in physically different positions (the phase angle is 90°, i.e. 2¼ times 40°, where 40° is double the rotor inter-blade angle), and the signals must be converted from the same point in the rotor blade wake, the IBLADE for the 'B' probe has to be increased by the appropriate amount, which is 576 (see sketch).



The operator is then informed that the system is ready for the next data scan. Depressing the RETURN key starts the data acquisition. Pacer mode (1 or 2), selected blade pair, increment to step through the 256 blade passage locations and the number of measurement repetitions at each location (i.e. at each IBLADE) are read from the control array. If the pacer is operated in mode 2 (i.e. selects a specific blade pair), the bit 15 is set by adding IADD = 100000B to the start and stop address. Refer to the RPACE description for details concerning how the data acquisition is performed. Not only the voltages, through subroutine RPACE, but also additional data are written into the raw data array. Some of the data are multiplied by 1,000,000 in order to be able to store all valid digits in integer constants and the average voltage AVRBE is set equivalent to the array IAVERGE(2) by an EQUIVALENCE statement.



Date and time are written into the raw data array also. If CNTRL(40) is set to 1, the wave as acquired is displayed on the terminal, which is selected by its logical unit number LA. Refer to the detailed description of subroutine PICTR for further information on how this is achieved; i.e. to use a non-graphics

terminal for plotting. The resolution of the terminal plot is is very limited. The option to display the just-acquired periodic high speed signal is designed to give the operator an opportunity to immediately verify the correctness of the data acquisition. Connecting a lead from KULITE amplifier output to an oscilloscope gives the investigator the chance to check digitized data against original analog data. If an error is encountered, the data scan may be repeated (Input : ... RE). Depressing the RETURN key causes the subroutine to proceed to the next task, the storing of the data. File name, ASCII converted security code and ASCII converted cartridge reference number are written into the raw data array. The raw data file is either created/opened and closed by subroutine PACER (CNTRL (39) is not equal 1) or this subroutine is called from subroutine ABSRV, which already has created/opened and positioned the raw data file and will close it (CNTRL (39) is set to 1). If, in the first mode, the automatically determined file name already exists, the operator either allows overwriting the existing file (Input: PU) or renames the current data file name (Input: any alphabetic character other than T). The starting record number is also written in the data array. If CNTRL (39) is not equal 1, the raw data file is closed and the data acquisition loop stops printing all the additional data on the documentation page. The accounting data are written back into the control array and the subroutine terminates.

DATA FILE: For more detailed information, study the key to the raw data file following this description. The default file name is T3rrss (rr ... ASCII converted run #, ss ... ASCII converted sequential #).

VARIABLES:

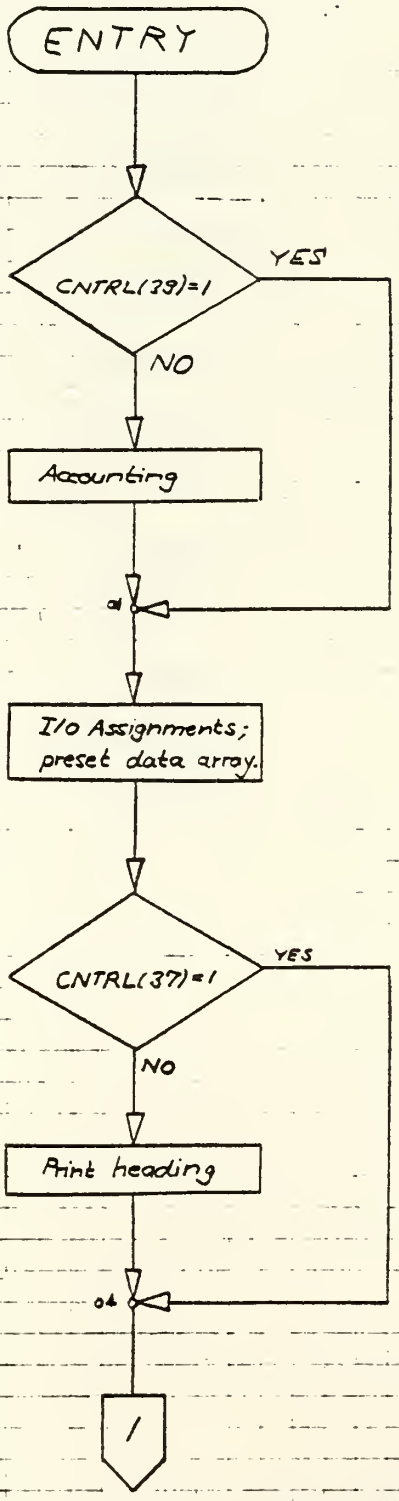
IBUF (1664)	integer	buffer array
CNTRL (256)	integer	control array
IDCB (144)	integer	data control block; used for FMP calls
IFILE (3)	integer	array to contain current file name
ISIZE (2)	integer	specifies # of records and record length in words
ISECU	integer	security code of data file
JSECU	integer	ASCII converted security code
ICR	integer	cartridge reference number, where data file is located
JCR	integer	ASCII converted cartridge reference number
NOLF	integer	suppresses line feed on terminal
NOCR (2)	integer	suppresses line feed and carriage return on terminal
ICLR (3)	integer	clear line above cursor
IBUF1 (384)	integer	raw data array, set equivalent to IBUF
IOXIM (9)	integer	array to contain probe positions in ASCII code

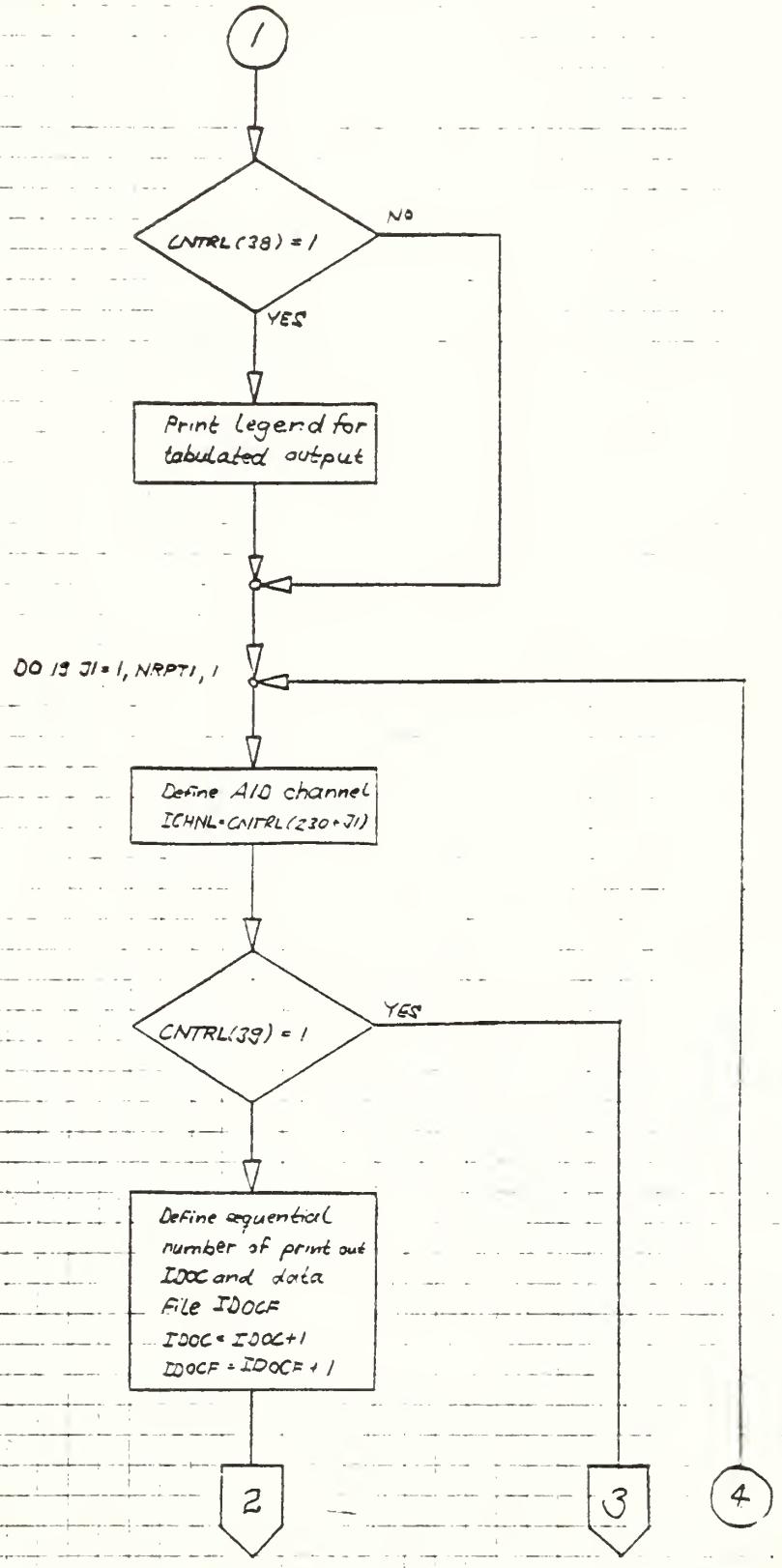
IAVRGE (2)	integer	array to contain average voltage, set equivalent to AVRGE
IDCBS	integer	length of data control block IDCB in words (here : 144)
IPAGE	integer	count of current page
IDOC	integer	count of current program run
IDOCF	integer	count of current data file sequential #
IL	integer	number of words to be transferred in FMP calls
ITYPE	integer	type of data file (here: 1)
IFRST	integer	standard for the first two characters of data file name
ISP	integer	control variable, used to space the output
LI	integer	LU# of standard input device (system console)
LO	integer	LU# of standard output device (line printer)
LA	integer	LU# of auxiliary output device (auxiliary terminal)
LS1	integer	LU# of scanner 1
LS2	integer	LU# of scanner 2
ISV1	integer	number of S/V controller 1
ISV4	integer	number of S/V controller 2
NRPT1	integer	number of KULITE measurements ('A', 'B', case KULITES)

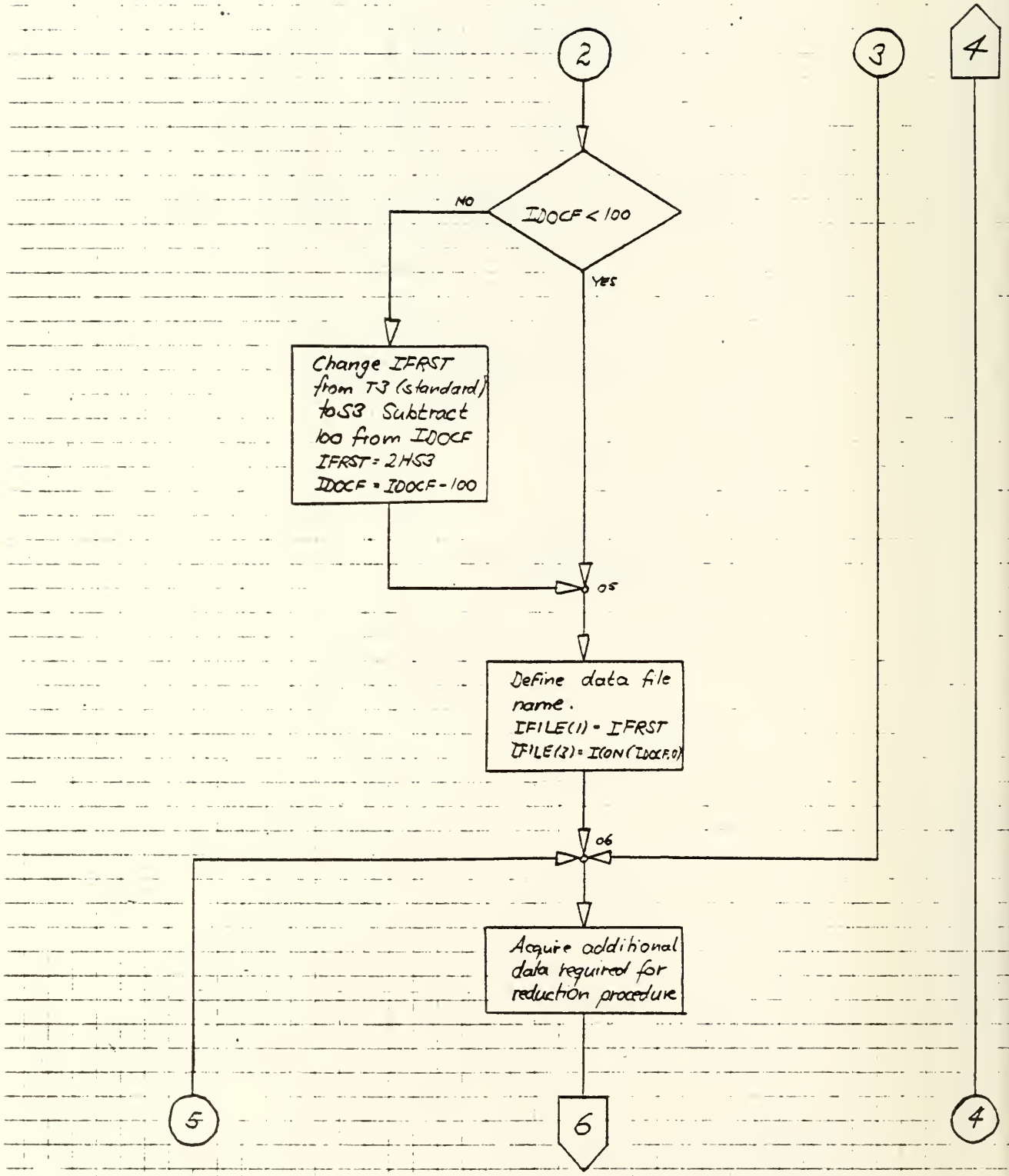
IW	integer	time delay between closing S/V part and reading transducer voltage From DVM
IMON	integer	ASCII converted month of the year
IDAY	integer	ASCII converted day of the month
IYEAR	integer	ASCII converted last two digits of current year
FREQ	real	RPM of the compressor
CIM	real	immersion of the combination probe
CYAW	real	yaw angle of the combination probe
PREF	real	reference pressure for the KULITE probes
P1	real	pressure P_1 from the combination probe
P23	real	pressure P_{23} from the combination probe
P4	real	pressure P_4 from the combination probe
E	real	thermocouple output, Station 'O'
DE	real	thermocouple differential output from 'O' across rotor
XIM	real	immersion of either 'A'- or 'B' probe
YAW	real	yaw angle of either 'A'- or 'B' probe
IADD	integer	variable to be added to start and stop address for paced run to

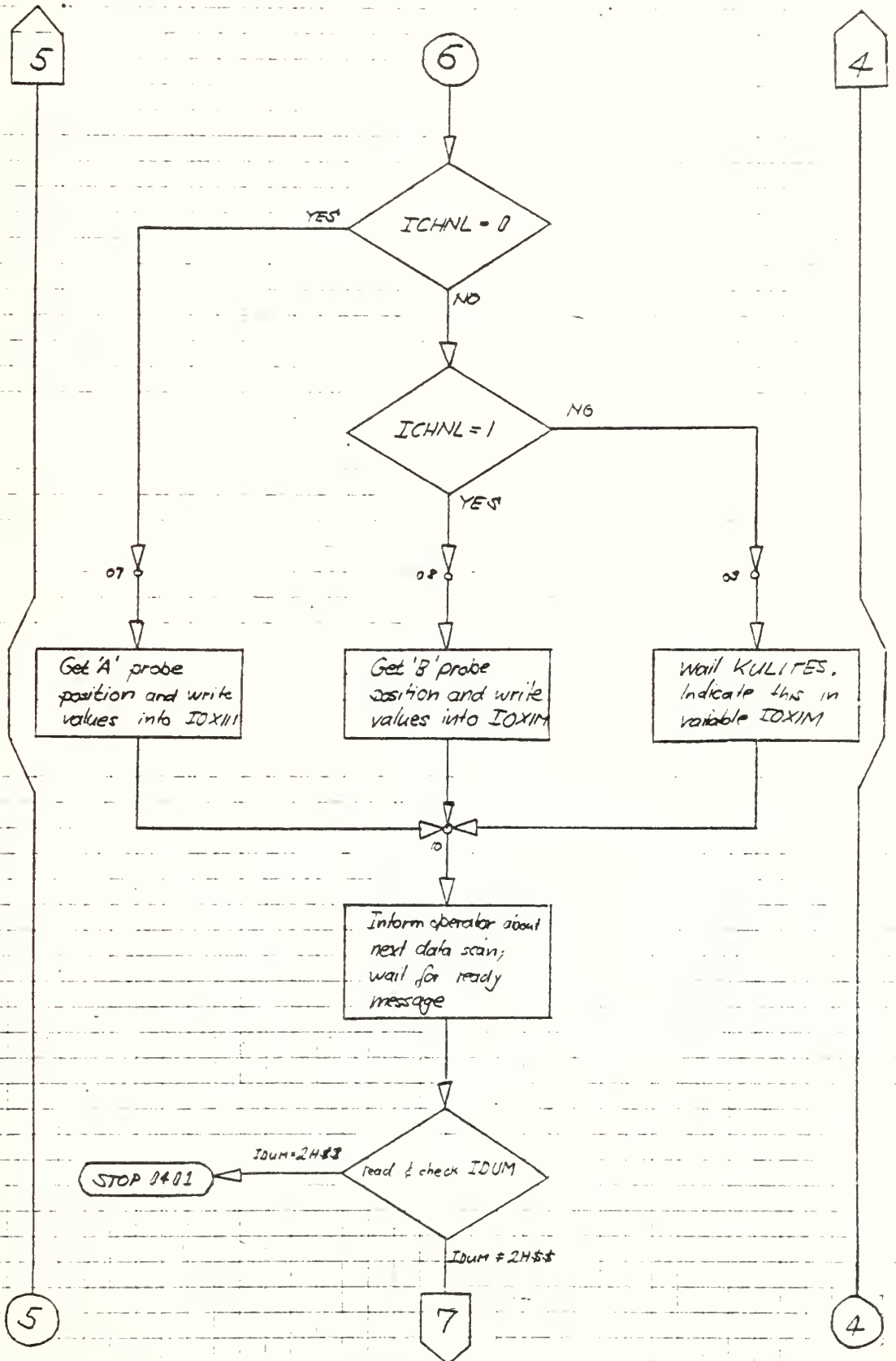
		compensate phase angle between these probes
IDUM	integer	decision variable
IPAMO	integer	pacer mode (1 or 2)
IPAIR	integer	selected blade pair
ISTART	integer	start address for paced run
ISTOP	integer	stop address for paced run
INCR	integer	increment for paced run
IRPT	integer	number of repetitions at each IBLADE
J111	integer	dummy variable
J222	integer	dummy variable
DUM	real	dummy variable
IERR	integer	error flag used by FMP calls
NEW	integer	scratch variable used to change file name

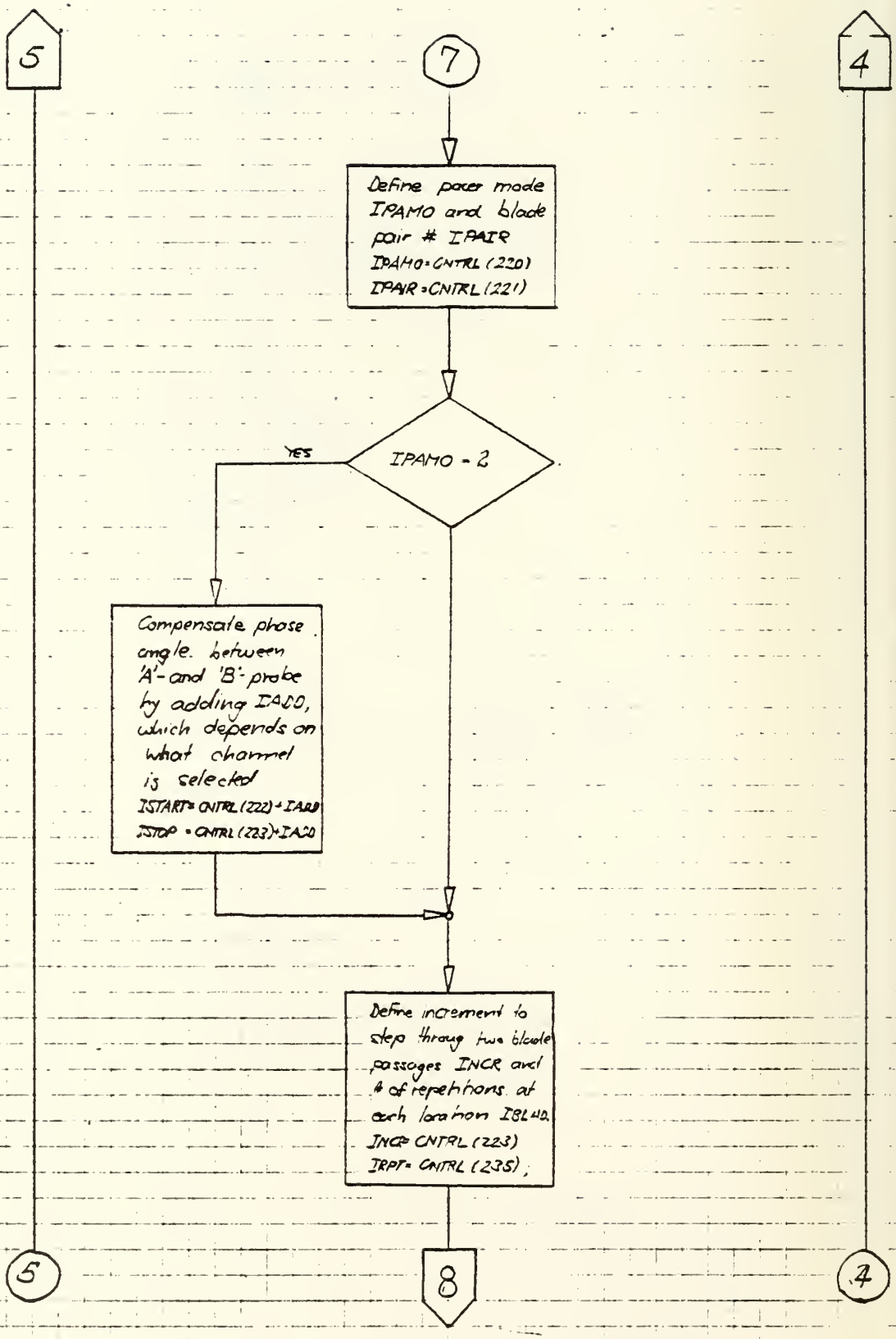
FLOW CHART SUBROUTINE PACER

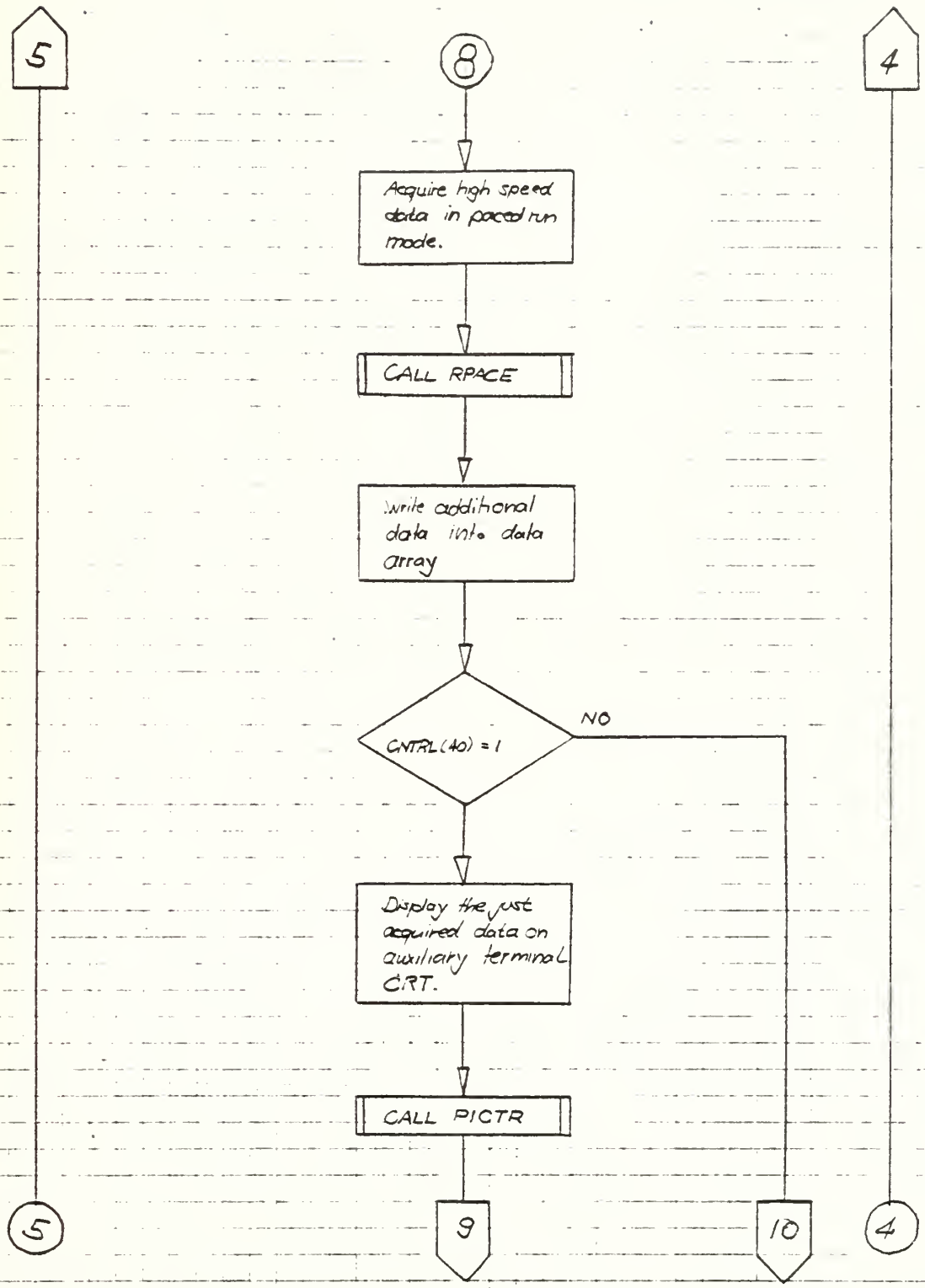


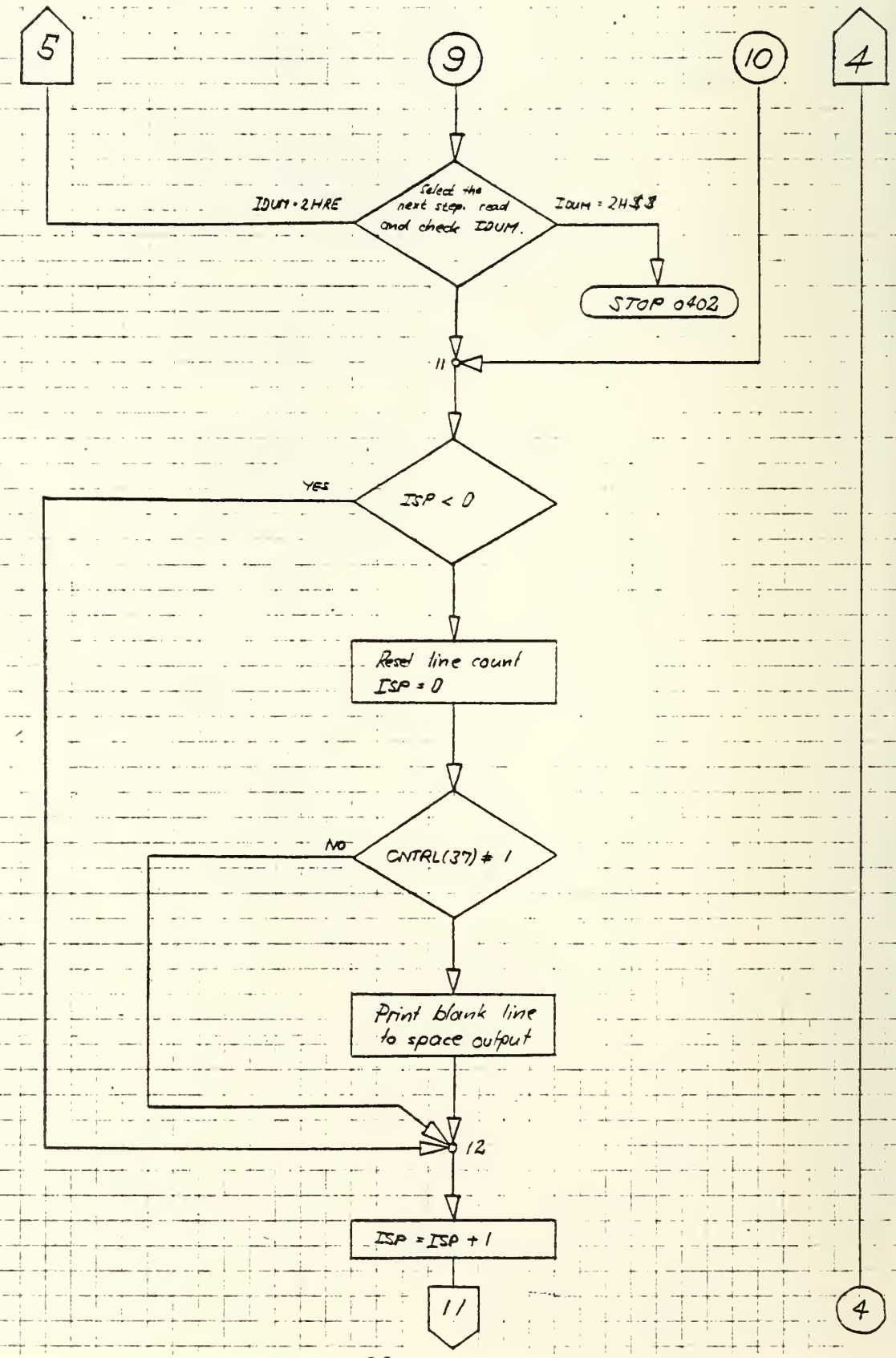

1
CNTRL(38) = 1
NO
YES
Print legend for tabulated output
DO 19 JI = 1, NRPTI, 1
Define A/D channel ICHNL = CNTRL(230 + JI)
CNTRL(39) = 1
YES
Define sequential number of print out IDOC and data file IDOCF
IDOC = IDOC + 1
IDOCF = IDOCF + 1
2
3
4

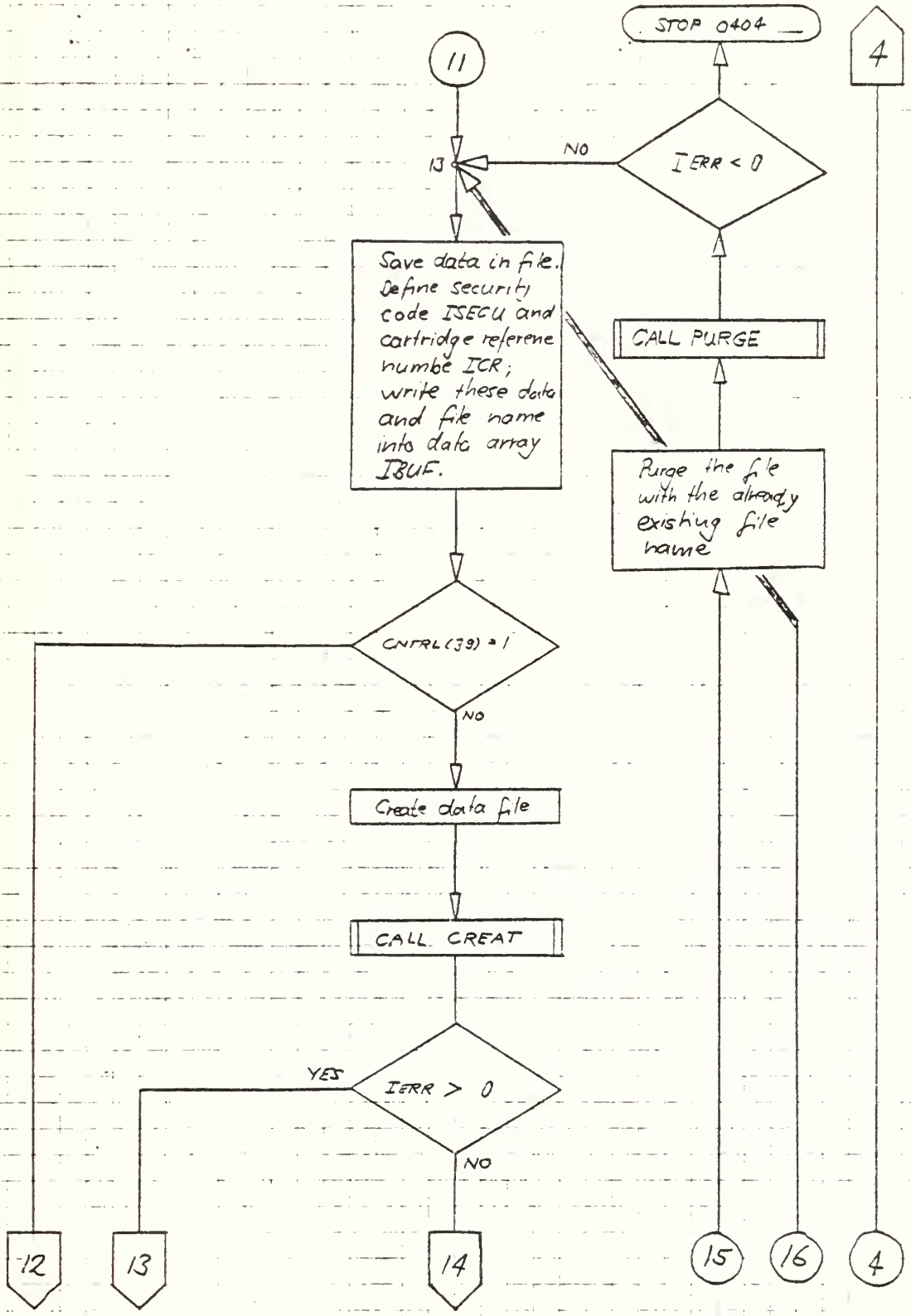

2
3
4
IDOCF < 100
NO
YES
Change IFRST from T3 (standard) to S3 Subtract 100 from IDOCF
IFRST = 2HS3
IDOCF = IDOCF - 100
05
Define data file name.
IFILE(1) = IFRST
IFILE(3) = ICON(IDOCF,0)
06
Acquire additional data required for reduction procedure
5
6
4

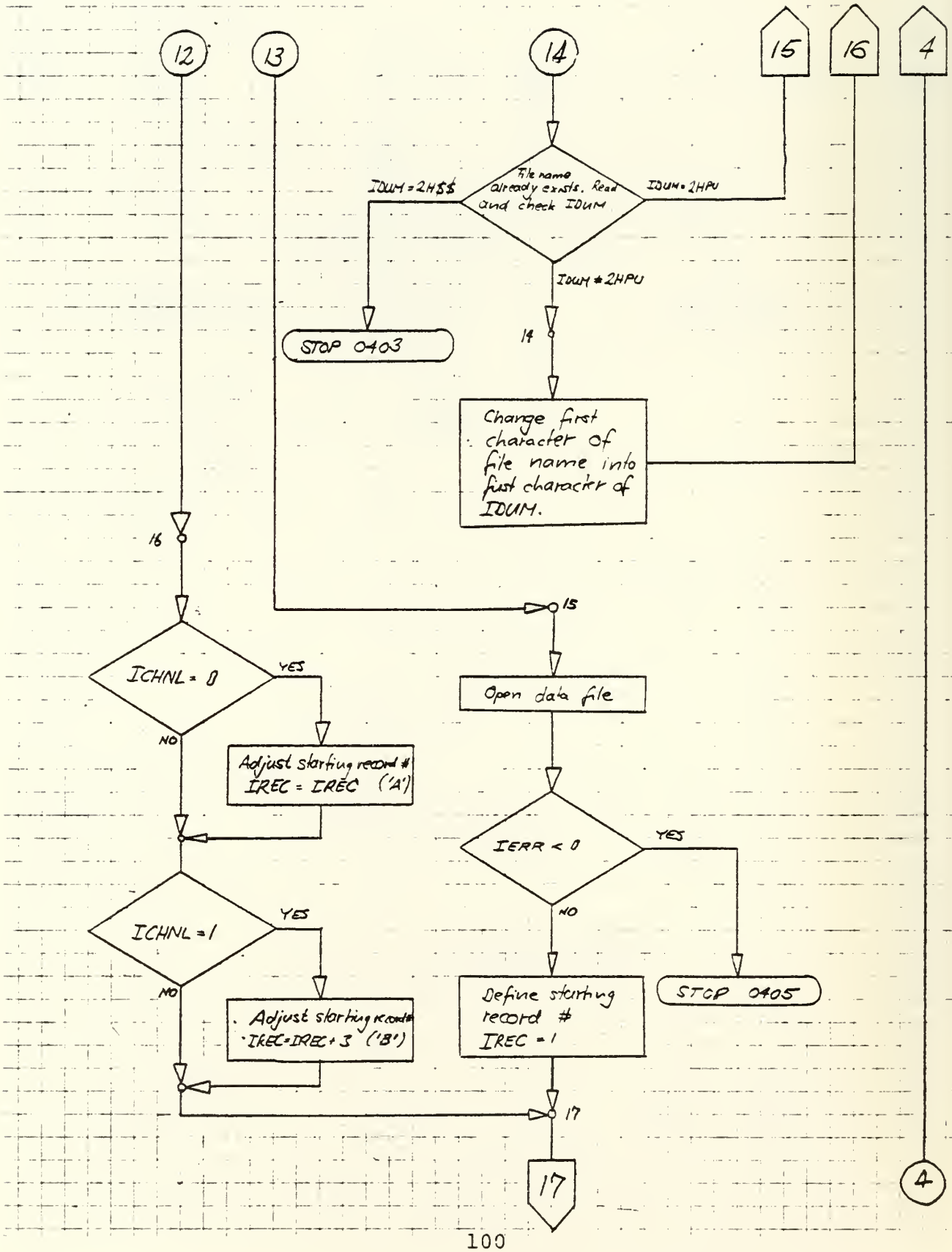

5
6
4
ICHNL = 0
YES
NO
ICHNL = 1
NO
YES
07
08
09
Get 'A' probe position and write values into IOXIM
Get 'B' probe position and write values into IOXIM
Wait KULITES. Indicate this in variable IOXIM
10
Inform operator about next data scan; wait for ready message
read & check IDUM
IDUM=2H$$
STOP 0401
IDUM ≠ 2H$$
5
7
4

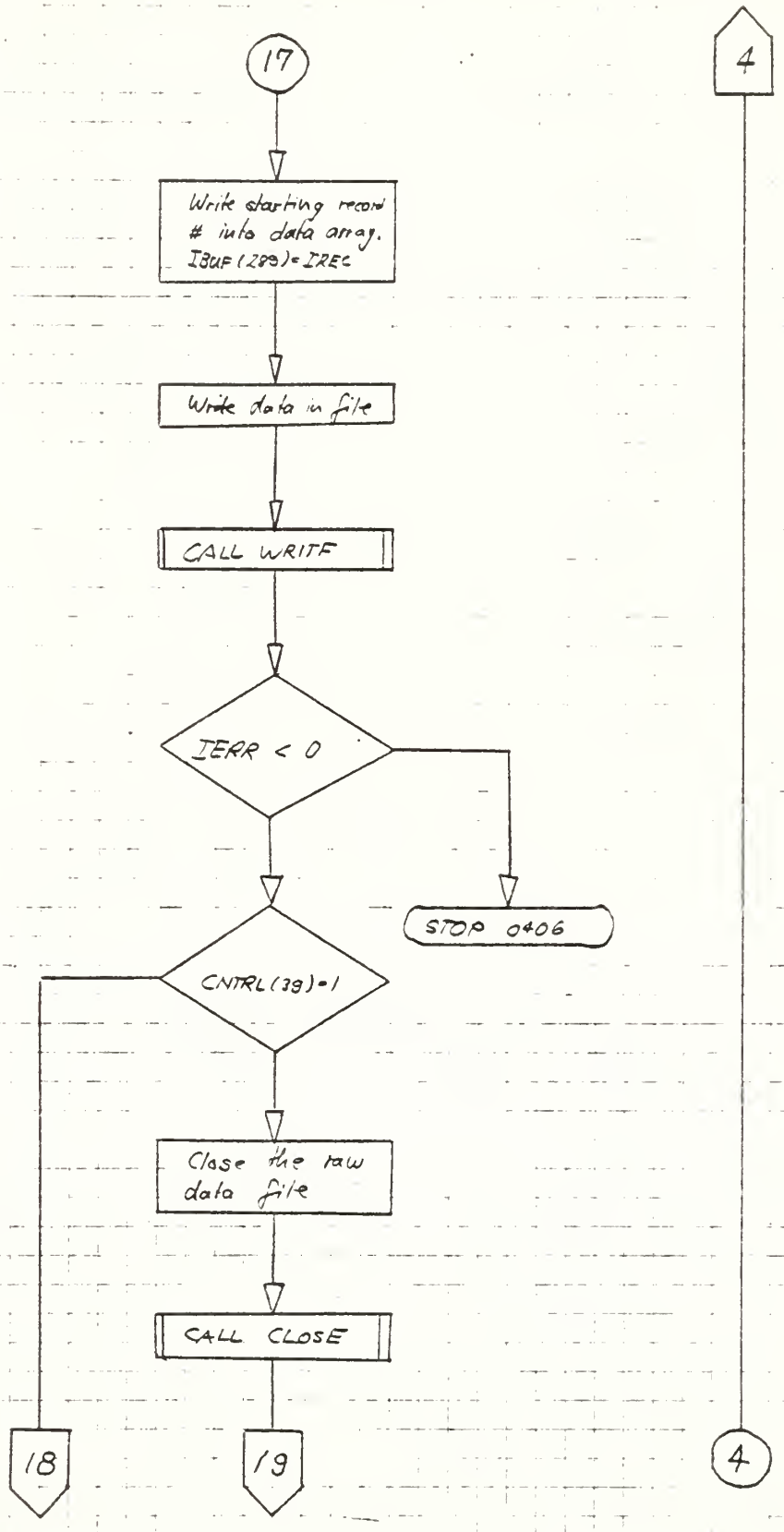

5
7
4
Define pacer mode IPAMO and blade pair # IPAIR
IPAMO=CNTRL(220)
IPAIR=CNTRL(221)
IPAMO = 2
YES
Compensate phase angle between 'A'- and 'B'- probe by adding IADD, which depends on what channel is selected
ISTART=CNTRL(222)+IADD
ISTOP =CNTRL(223)+IADD
Define increment to step through two blade passages INCR and # of repetitions at each location IBLND
INCR=CNTRL(223)
IRPT=CNTRL(235),
5
8
4

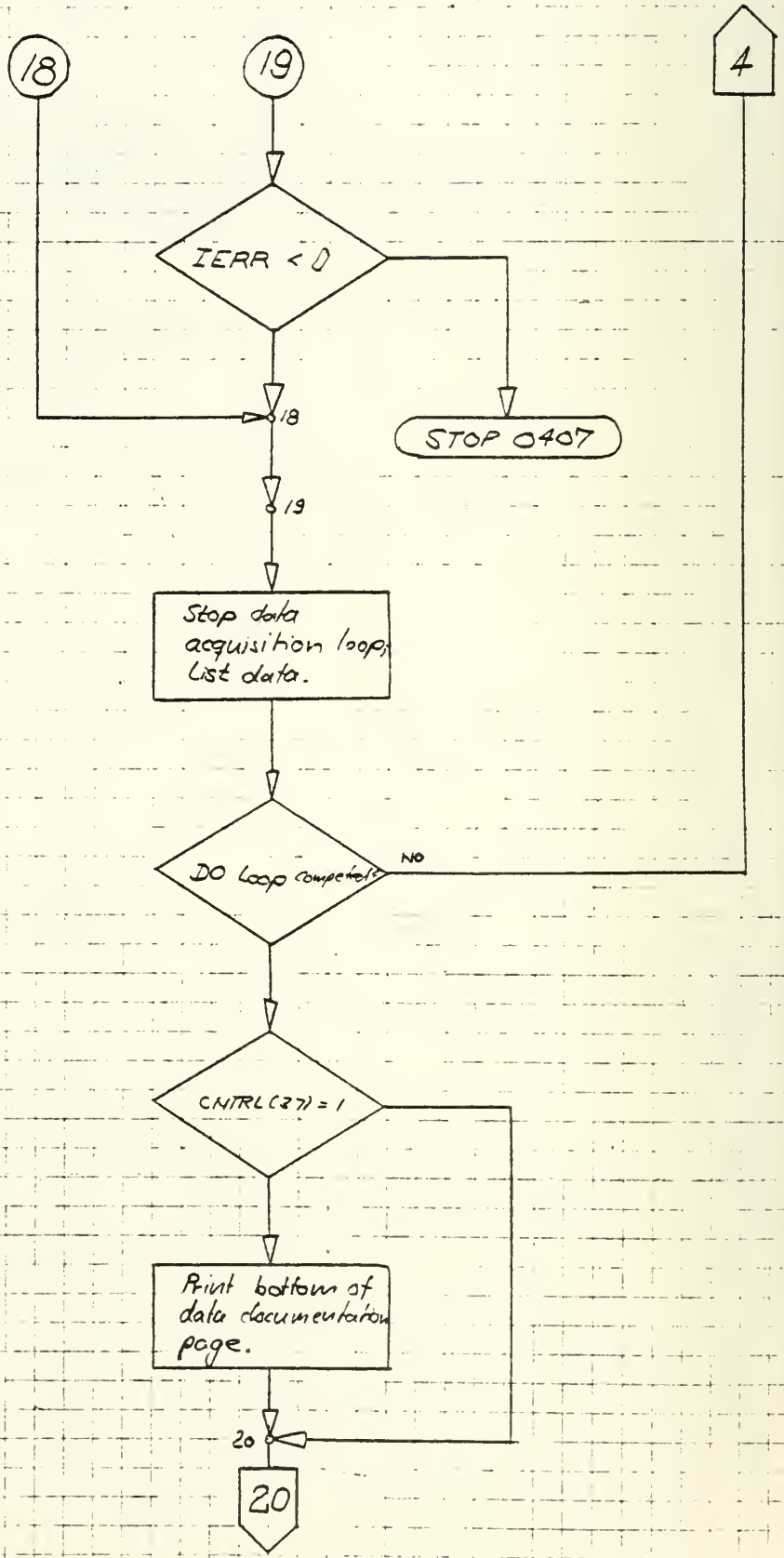

5
8
4
Acquire high speed data in paced run mode.
CALL RPACE
Write additional data into data array
CNTRL(40) = 1
NO
Display the just acquired data on auxiliary terminal CRT.
CALL PICTR
5
9
10
4

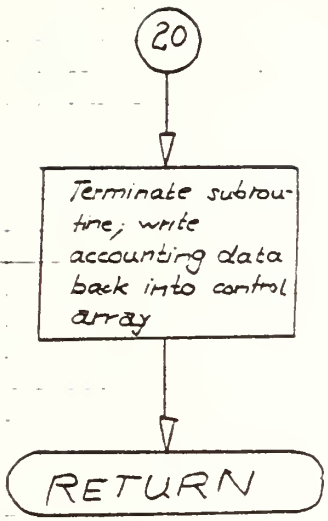

5
9
10
4
Select the next step, read and check IDUM.
IDUM = 2HRE
IDUM = 2H$$
STOP 0402
11
ISP < 0
YES
Reset line count ISP = 0
CNTRL(37) ≠ 1
NO
Print blank line to space output
12
ISP = ISP + 1
11
4


11
13
STOP 0404
4
NO
IERR < 0
Save data in file. Define security code ISECU and cartridge referene numbe ICR; write these data and file name into data array IBUF.
CALL PURGE
Purge the file with the already existing file name
CNTRL(39) = 1
NO
Create data file
CALL CREAT
YES
IERR > 0
NO
12
13
14
15
16
4


12
13
14
15
16
4
File name already exists. Read and check IDUM
IDUM = 2H$$
IDUM = 2HPU
IDUM ≠ 2HPU
STOP 0403
14
Change first character of file name into fust character of IDUM.
16
15
ICHNL = 0
YES
NO
Adjust starting record # IREC = IREC ('A')
Open data file
IERR < 0
YES
NO
ICHNL = 1
YES
NO
Adjust starting record # IREC = IREC + 3 ('B')
Define starting record # IREC = 1
STOP 0405
17
17
4


17
4
Write starting record # into data array. IBUF(289)=IREC
Write data in file
CALL WRITF
IERR < 0
STOP 0406
CNTRL(39)=1
Close the raw data file
CALL CLOSE
18
19
4


18
19
4
IERR < 0
STOP 0407
18
19
Stop data acquisition loop; List data.
DO Loop completed?
NO
CNTRL(27) = 1
Print bottom of data documentation page.
20
20


20
Terminate subroutine; write accounting data back into control array
RETURN

4.6. PROGRAM LISTING TXC01

```
PAGE 0001  FTN.   2:47 PM  MON., 25  AUG., 1980

0001  FTN4,L
0002        BLOCK DATA
0003       *, / FMP    / IDCB(144),IFILE(3),ISIZE(2),ISECU,ICR
0004        COMMON / FMP    / IDCB,IFILE,ISIZE,ISECU,ICR
0005        INTEGER IDCB(144),IFILE(3),ISIZE(2)
0006        END

 FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)
 **  NO WARNINGS **  NO ERRORS **
BLOCK COMMON FMP     SIZE =  00151
```

```
0007          BLOCK DATA
0008         *, / CIBUF / IBUF(1664)
0009          COMMON / CIBUF / IBUF
0010          INTEGER IBUF(1664)
0011          END
```

```
  FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)
  ** NO WARNINGS **  NO ERRORS **
 BLOCK COMMON CIBUF  SIZE =  01664
```

```
PAGE 0003  FTN.   2:47 PM  MON., 25  AUG., 1980

0012          BLOCK DATA
0013         *, / CONTR / CNTRL(256)
0014          COMMON / CONTR / CNTRL
0015          INTEGER CNTRL(256)
0016          END

  FTN4 COMPILER: HP92060-16092_REV. 1926 (790430)
  **  NO WARNINGS **  NO ERRORS **
 BLOCK COMMON CONTR  SIZE =  00256
```

```
0017          PROGRAM TXCO1 (3,99)
0018    C     .....................................................................
0019    C     .                                                                   .
0020    C     .  The operating system RTE IV B requests the data acquisition      .
0021    C     .  program TXCO for the one stage transsonic compressor to be       .
0022    C     .  split into several programs schduled by the father program       .
0023    C     .  program TXCOO.  This son program TXCO1 consists of the sub-      .
0024    C     .  routines ABSRV, CALIB, FREER and PACER.  These handle the        .
0025    C     .  acquisition of high speed data.  The data transfer between       .
0026    C     .  father and son program takes place via the control array         .
0027    C     .  file CONTR (disc file CNTRLF) and the data array IBUF (disc      .
0028    C     .  file IBUFF).                                                     .
0029    C     .  The utility subroutines ACQN, CNTL, CURVE, ICON, IPORT,          .
0030    C     .  PICTR, REWRF, RPACE, SCANR, TIME and WAIT are added.             .
0031    C     .  Author:     Hans M. Zebner                                       .
0032    C     .  Date  :     March 12, 1980                                       .
0033    C     .  A detailed program description is available in the TXCO log.     .
0034    C     .  Comment statements ans statement numbers in the source code      .
0035    C     .  match to yhe program description.  This program is part of       .
0036    C     .  the TXCO transonic compressor investigation program system.      .
0037    C     .                                                                   .
0038    C     .....................................................................
0039          *, First son program of father program TXCO.

0040          COMMON / CONTR / CNTRL
0041
0042          INTEGER CNTRL(256)
0043
0044          DATA NOLF  /006537B/
0045      101 FORMAT (9X""20X""A2)
0046      102 FORMAT ("  TXCOO : PROGRAM ABORTED!  NO SUBROUTINE HAS BE
0047         *EN INITIALIZED.")
0048      801 FORMAT ("CA")
0049     1001 FORMAT ("F1R7M3A1H0T3")
0050     1201 FORMAT ("PF4G6T")
0051     1501 FORMAT ("CA")
0052
0053          CALL REWRF (-1,2)
0054          LI = CNTRL(19)
0055          IF ( CNTRL(50)  .LT.  1  .OR.  CNTRL(50)  .GT.  4 ) GO TO 05
0056
0057    C     .....................................................................
0058    C     .                                                                   .
0059    C     .  Set interface bus and devices to remote control.                 .
0060    C     .                                                                   .
0061    C     .....................................................................
0062          CALL ABRT (7,2)
0063          CALL RMOTE (8)
0064          CALL RMOTE (10)
0065          CALL RMOTE (12)
0066          CALL RMOTE (15)
0067          WRITE ( 8, 801)
0068          WRITE (10,1001)
0069          WRITE (12,1201)
0070          WRITE (15,1501)
0071
0072    C     .....................................................................
0073    C     .                                                                   .
0074    C     .  Call subroutine indicated by CNTRL(50).                          .
0075    C     .                                                                   .
0076    C     .....................................................................
0077          ISTOP = CNTRL(50)
0078          IF ( CNTRL(50)  .EQ.  1 ) CALL ABSRV
0079          IF ( CNTRL(50)  .EQ.  2 ) CALL CALIB
0080          IF ( CNTRL(50)  .EQ.  3 ) CALL FREER (X1,X2,X3)
0081          IF ( CNTRL(50)  .EQ.  4 ) CALL PACER (1)
0082
0083    C     .....................................................................
0084    C     .                                                                   .
0085    C     .  Release interface bus and devices from remote control.           .
0086    C     .                                                                   .
0087    C     .....................................................................
0088          CALL CLEAR (7,1)
0089          CALL LOCL (7)
0090
0091          CALL REWRF (1,2)
```

```
0092          WRITE (LI, 101) NOLF
0093          GO TO (01,02,03,04) ISTOP
0094       01 STOP 0177
0095       02 STOP 0277
0096       03 STOP 0377
0097       04 STOP 0477
0098       05 WRITE (LI, 102)
0099          END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 00257 COMMON = 00000

```
0100          SUBROUTINE ABSRV
0101    C     ...............................................................
0102    CC    .                                                             .
0103    CC    .  Subroutine to acquire high speed data from the 1-stage axial  .
0104    CC    .  transonic compressor using miniaturized probes equipped with  .
0105    CC    .  KULITE semiconductor pressure transducers.                    .
0106    CC    .  Author:     Hans Zebner                                       .
0107    CC    .  Date:       August 12, 1980                                   .
0108    CC    .  A detailed program description is available in the TXCO log.  .
0109    CC    .  Comment statements and statement numbers in the source code   .
0110    CC    .  match to the program description.  This subroutine is part of .
0111    CC    .  the TXCO transonic compressor investigation program system.    .
0112    CC    .                                                                .
0113    C     ...............................................................
0114         *, Takes data from the 'A' - 'B' - probe system.
0115
0116          COMMON / CIBUF / IBUF
0117          COMMON / CONTR / CNTRL
0118          COMMON / FMP   / IDCB,IFILE,ISIZE,ISECU,ICR
0119
0120          INTEGER IBUF(1664)
0121          INTEGER CNTRL(256)
0122          INTEGER IDCB(144),IFILE(3),ISIZE(2)
0123
0124          REAL POS(7),RBUF(64)
0125          INTEGER NOLF,NOCR(2),ICLR(3)
0126
0127          EQUIVALENCE (IBUF(1),RBUF(1))
0128
0129          DATA NOLF  /006537B/
0130          DATA NOCR  /000033B,040433B/
0131          DATA ICLR  /015524B,015515B,006537B/
0132          DATA IDCBS /144/
0133
0134    C     FORMATS ABSRV START
0135      101 FORMAT ("  Did you calibrate the type 'A' and type 'B' probes
0136         *  on line?          ",3("A"),2A2)
0137      102 FORMAT (A2)
0138      103 FORMAT (/" "79X""A2/"  Since you forgot to calibrate
0139         *these nice probes, I will do it right now."6X""A2/"  P
0140         *ress the RETURN key to continue the execution of the p
0141         *rogram!"16X""A2/" "79X""A2/)
0142      104 FORMAT ("  ABSRV : CALL CALIB")
0143      105 FORMAT (/"  Enter the following results from the on line cali
0144         *bration!" 5X""/
0145         *"    PBARO    PREF  AVRGEA  AVRGEB
0146         * SLOPEA  SECONA  SLOPEB  SECONB"/
0147         *"          ",7("  "),A2)
0148      106 FORMAT (1X,F7.2,1X,7(F7.6,1X))
0149      107 FORMAT ("  How many yaw positions for the type 'A' and type '
0150         *B' probe?       ",2(""),2A2)
0151      108 FORMAT ("WARNING: file "3A2" already exists!  Type PU to "
0152         *"allow purge or enter any char-",
0153         */,"          acter but T to change file name."38X)
0154      109 FORMAT ("  ABSRV : PURGE  "3A2":"A2":"A2)
0155      110 FORMAT (A1"1")
0156      111 FORMAT ("  ABSRV : File name "3A2" succesfully changed to "3A2)
0157      112 FORMAT ("  ABSRV : CREATE "3A2":"A2":"A2":"I1":"I2":"I3)
0158      113 FORMAT (""15X"Read the probe positions;  Yaw Angle and Immersi
0159         *on."14X""A2)
0160      114 FORMAT (" Enter case angle"34X,2A2)
0161      115 FORMAT (/21X"Immersion"11X"Yaw Angle"/
0162         *24X"inches"19X" "/
0163         *"  Combination probe "F10.3,10X,F10.3""/
0164         *"      Type 'A' probe "F10.3,10X,F10.3""/
0165         *"      Type 'B' probe "F10.3,10X,F10.3""//
0166         *"          Case angle "20X""F10.3""//
0167         *"Type  UP  to update those readings"/
0168         *"      TA  to take a data set at this constellation"/
0169         *"        "2A2)
0170      116 FORMAT ("  ABSRV : CALL PACER("I2")")
0171      117 FORMAT ( /" "79X""A2/"  Check raw data from this"I2".
0172         * yaw position for obvious errors!"18X""A2/" "79X""
0173         *A2/
0174         *"  Type  RE  to repeat this point"48X""A2/
```

```
0175        *"          NE  to proceed to the next point"40X""A2/
0176        *".          EN  to terminate the 'A'-'B'-probe survey at
0177        *this radius/operating point"A2/
0178        *" "7X"  "70X""A2/
0179        *8X"  ",2(""),2A2)
0180     118 FORMAT ("  Error: You want to proceed to the"I2". positio
0181        *n, but the data array only"8X""A2/
0182        *"  can store"I2" positions, that you defined previuosly!"37X"
0183        *"A2)
0184     149 FORMAT (""((3A2)))
0185
0186     601 FORMAT (1H ,15(1H ),33HTranssonic Compressor Test Run # ,I7)
0187     602 FORMAT (1H ,28(1H ),6HDate: ,A2,1H/,A2,1H/,A2)
0188     603 FORMAT (1H ,"",29(1H ),6HTime: ,A2,1H.,A2,3H  h,/////)
0189     604 FORMAT (1H ,"",/////,8X
0190        *,"> A >  ...  > B >  ---  Probes Pace "I3" . ",
0191        */////)
0192     605 FORMAT (" "72X""//"*"41X"'' I2 " .  Yaw position")
0193     606 FORMAT (/42X"'' I2 " .  Yaw position"/" "72X"")
0194     607 FORMAT ("
```

",28(1H),6HTime: ,A2,1H.,A2,3H h)

```
0195  C     FORMAT$ ABSRV STOP
0196
0197
0198
0199  C     .....................................................................
0200  CC    .                                                                   .
0201  CC    .  Accounting.                                                      .
0202  CC    .                                                                   .
0203  C     .....................................................................
0204        IPAGE    = CNTRL(212)
0205        IDOC     = CNTRL(213)
0206        IDOCF    = CNTRL(213)
0207        IPAGE    = IPAGE+1
0208        IDOC     = IDOC+1
0209        IDOCF    = IDOCF+1
0210        ISECU    = CNTRL(31)
0211        ICR      = CNTRL(30)
0212        ISIZE(2) = 128
0213        IFILE(2) = ICON(CNTRL(4),0)
0214        IL       = 128
0215        ITYPE    = 1
0216        IFRST    = 2HT1
0217
0218
0219
0220  C     .....................................................................
0221  C     .                                                                   .
0222  C     .  I/O Assignments;  preset data array.                             .
0223  C     .                                                                   .
0224  C     .....................................................................
0225        LI       = CNTRL(19)
0226        LO       = CNTRL(20)
0227        LS1      = CNTRL(71)
0228        LS2      = CNTRL(72)
0229        DO 01 I=1,768,1
0230     01 IBUF(I)= 025052B
0231
0232
0233
0234  C     .....................................................................
0235  C     .                                                                   .
0236  C     .  Ask operator, whether the 'A'-'B'-probe system has been          .
0237  C     .  calibrated on line.                                              .
0238  C     .                                                                   .
0239  C     .....................................................................
0240        WRITE (LI, 101) NOCR
0241        READ  (LI, 102) ICAL
0242        WRITE (LI, 149) ICLR
0243        IF ( ICAL  .EQ.  2H$$ ) STOP 0101
0244        IF ( ICAL  .NE.  2HNO ) GO TO 02
0245
0246
0247
0248  C     .....................................................................
0249  C     .                                                                   .
```

```
0250   C      .  Call subroutine CALIB to calibrate 'A'-'B'-probe system.      .
0251   C      .                                                                .
0252   C      ..................................................................
0253          WRITE (LI, 103) (NOLF,I=1,4,1)
0254          READ  (LI, 102) IDUM
0255          WRITE (LI, 149) (ICLR,I=1,7,1)
0256          IF ( IDUM  .EQ.  2H$$ ) STOP 0102
0257          WRITE (LI, 104)
0258          CALL CALIB
0259
0260
0261
0262   C      ..................................................................
0263   C      .                                                                .
0264   C      .  Enter calibration results;  print heading.                    .
0265   C      .                                                                .
0266   C      ..................................................................
0267       02 WRITE (LI, 105) NOLF
0268          READ  (LI, 106) SLOPEA,SECONA,SLOPEB,SECONB,AVRGEA,AVRGEB,PBARO
0269          WRITE (LI, 149) (ICLR,I=1,4,1)
0270          CALL TIME (IMON,IYEAR,IDAY,IHOUR,IMIN)
0271          WRITE (LO, 601) CNTRL(4)
0272          WRITE (LO, 602) IMON,IYEAR,IDAY
0273          WRITE (LO, 603) IHOUR,IMIN
0274          WRITE (LO, 604) IPAGE
0275
0276
0277
0278   C      ..................................................................
0279   C      .                                                                .
0280   C      .  Initialize data acquisition;  create raw data file of the     .
0281   C      .  correct size.  If the file name assigned to this data set     .
0282   C      .  already exists, the operator decides, whether to purge the    .
0283   C      .  already existing file (PU) or change this file name.          .
0284   C      .                                                                .
0285   C      ..................................................................
0286          WRITE (LI, 107) NCCR
0287          READ  (LI,   *) NPOS
0288          WRITE (LI, 149) ICLR
0289          ISIZE(1) = 1+NPOS*6
0290          IF ( IDOCF  .LT.  100 ) GO TO 03
0291          IFRST    = 2HS1
0292          IDOCF    = IDOCF-100
0293       03 IFILE(1) = IFRST
0294          IFILE(3) = ICON(IDOCF,0)
0295       04 CALL CREAT (IDCB,IERR,IFILE,ISIZE,ITYPE,ISECU,ICR,IDCBS)
0296          IF ( IERR  .GT.  0 ) GO TO 06
0297          WRITE (LI, 108) IFILE
0298          READ  (LI, 102) IDUM
0299          WRITE (LI, 149) (ICLR,I=1,3)
0300          IF ( IDUM  .EQ.  2H$$ ) STOP 0103
0301          IF ( IDUM  .NE.  2HPU ) GO TO 05
0302          JSECU = ICON(ISECU,0)
0303          JCR   = ICON(ICR,0)
0304          WRITE (LI, 109) IFILE,JSECU,JCR
0305          CALL PURGE (IDCB,IERR,IFILE,ISECU,ICR)
0306          IF ( IERR  .LT.  0 ) STOP 0104
0307          GO TO 04
0308       05 CALL CODE
0309          WRITE (NEW,110) IDUM
0310          WRITE (LI, 111) IFILE,NEW,IFILE(2),IFILE(3)
0311          IFILE(1) = NEW
0312          GO TO 04
0313       06 CALL OPEN  (IDCB,IERR,IFILE,IOPTN,ISECU,ICR,IDCBS)
0314          IF ( IERR  .LT.  0 ) STOP 0105
0315          DO 07 I=1,NPOS,1
0316          IREC   = 1+(I-1)*6
0317          CALL WRITF (IDCB,IERR,IBUF,768,IREC)
0318          IF ( IERR  .LT.  0 ) STOP 0106
0319       07 CONTINUE
0320          JSECU  = ICON(ISECU,0)
0321          JCR    = ICON(ICR,0)
0322          WRITE (LI, 112) IFILE,JSECU,JCR,ITYPE,ISIZE
0323
0324
```

```
0325
0326   C      .....................................................................
0327   C      .                                                                   .
0328   C      .  Position the raw data file is done by subroutine ABSRV.  The    .
0329   C      .  actual data are written in the data file by subroutine PACER.   .
0330   C      .  CNTRL(37) is set to 1 in order to suppress printing a heading   .
0331   C      .  in subroutine PACER.  CNTRL(39) is set to 1 to tell subrou-     .
0332   C      .  tine PACER not to create/open and close a new data file.        .
0333   C      .                                                                   .
0334   C      .....................................................................
0335          IPOS   = 0
0336       08 IPOS   = IPOS+1
0337          IF ( IPOS  .GT.  NPOS ) GO TO 19
0338       09 CNTRL(37) = 1
0339          CNTRL(38) = IPOS
0340          CNTRL(39) = 1
0341          IF ( IPOS  .EQ.  1 ) WRITE (LO, 605) IPOS
0342          IF ( IPOS  .GT.  1 ) WRITE (LO, 606) IPOS
0343          IREC   = 2+(IPOS-1)*6
0344          CALL POSNT (IDCB,IERR,1,IREC)
0345          IF ( IERR  .LT.  0 ) STOP 0107
0346
0347
0348
0349   C      .....................................................................
0350   C      .                                                                   .
0351   C      .  Check position of probes before acquiring data.                 .
0352   C      .                                                                   .
0353   C      .....................................................................
0354       10 WRITE (LI, 113) NOLF
0355          IC     = 1
0356          I2     = 1
0357          DO 11 J=30,35,1
0358          POS(I2)= SCANR(LS1,J,IC)
0359       11 I2     = I2+1
0360          DO 12 J=1,5,2
0361       12 POS(J) = POS(J)*1000.
0362          DO 13 J=2,6,2
0363       13 POS(J) = POS(J)*10000.
0364          WRITE (LI, 149) ICLR
0365          WRITE (LI, 114) NOCR
0366          READ  (LI,   *) POS(7)
0367          WRITE (LI, 149) ICLR
0368       14 WRITE (LI, 115) (POS(J),J=1,7,1),NOCR
0369          READ  (LI, 102) IDUM
0370          WRITE (LI, 149) (ICLR,I=1,12,1)
0371          IF ( IDUM  .EQ.  2HUP ) GO TO 10
0372          IF ( IDUM  .EQ.  2HTA ) GO TO 15
0373          IF ( IDUM  .EQ.  2H$$ ) STOP 0110
0374          GO TO 14
0375
0376
0377
0378   C      .....................................................................
0379   C      .                                                                   .
0380   C      .  Acquire data in subroutine PACER.                               .
0381   C      .                                                                   .
0382   C      .....................................................................
0383       15 WRITE (LI, 116) IREC
0384          CALL PACER (IREC)
0385
0386
0387
0388   C      .....................................................................
0389   C      .                                                                   .
0390   C      .  Select the next step:                                           .
0391   C      .    RE       repeat the data acquisition at this yaw position     .
0392   C      .    NE       proceed to the nect yaw position                     .
0393   C      .    EN       terminate the survey at this operating point         .
0394   C      .                                                                   .
0395   C      .....................................................................
0396       16 WRITE (LI, 117) NOLF,IPOS,(NOLF,I=1,6,1),NOCR
0397          READ  (LI, 102) IDUM
0398          WRITE (LI, 149) (ICLR,I=1,9,1)
0399          IF ( IDUM  .EQ.  2HNE ) GO TO 08
```

```
0400          IF ( IDUM  .EQ.  2HRE ) GO TO 09
0401          IF ( IDUM  .EQ.  2HEN ) GO TO 17
0402          IF ( IDUM  .EQ.  2H$$ ) STOP 0111
0403          GO TO 16
0404
0405
0406
0407    C     .....................................................................
0408    C     .                                                                   .
0409    C     .  Stop data acquisition.  Write additional data (i.e. barome-      .
0410    C     .  tric pressure, calibration results, number of points and yaw     .
0411    C     .  positions into first record (Directory) of the data file.        .
0412    C     .                                                                   .
0413    C     .....................................................................
0414       17 CONTINUE
0415          DO 18  I=1,128,1
0416       18 IBUF(I) = 0250528
0417          IBUF(1) = 256
0418          IBUF(2) = NPOS
0419          RBUF(2) = PBARO
0420          RBUF(3) = PREF
0421          RBUF(4) = AVRGEA
0422          RBUF(5) = AVRGEB
0423          RBUF(6) = SLOPEA
0424          RBUF(7) = SECONA
0425          RBUF(8) = SLOPEB
0426          RBUF(9) = SECONB
0427          CALL TIME (IBUF(96),IBUF(104),IBUF(112),IBUF(120),IBUF(128))
0428          IREC    = 1
0429          CALL WRITF (IDCB,IERR,IBUF,IL,IREC)
0430          IF ( IERR  .LT.  0 ) STOP 0112
0431          CALL CLOSE (IDCB,IERR)
0432          IF ( IERR  .LT.  0 ) STOP 0113
0433          WRITE (LO, 607) IBUF(120),IBUF(128)
0434
0435
0436
0437    C     .....................................................................
0438    C     .                                                                   .
0439    C     .  Terminate subroutine;  write accounting variables back into      .
0440    C     .  control array.                                                   .
0441    C     .                                                                   .
0442    C     .....................................................................
0443          CNTRL(212) = IPAGE
0444          CNTRL(213) = IDOC
0445          CNTRL( 50) = -1
0446          RETURN
0447
0448
0449
0450    C     .....................................................................
0451    C     .                                                                   .
0452    C     .  Error returns.                                                   .
0453    C     .                                                                   .
0454    C     .....................................................................
0455       19 WRITE (LI, 118) IPOS,NOLF,NPOS,NOLF
0456          GO TO 17
0457          END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 02498 COMMON = 00000

```
0458          SUBROUTINE CALIB
0459    C     .....................................................................
0460    C     .                                                                   .
0461    C     .  Subroutine to control the on line calibration of the KULITE      .
0462    C     .  type 'A'-'B'-probe system.                                       .
0463    C     .  Author:     Hans Zebner                                          .
0464    C     .  Date:       August 13, 1980                                      .
0465    C     .  A detailed program description is available in the TXCO log.     .
0466    C     .  Comment statements and statement numbers in the source code      .
0467    C     .  match to the program description.  This subroutine is part of    .
0468    C     .  the TXCO transonic compressor investigation program system.      .
0469    C     .                                                                   .
0470    C     .....................................................................
0471         *, On-line calibration of KULITE probes.
0472
0473          COMMON / CONTR / CNTRL
0474
0475          INTEGER CNTRL(256)
0476
0477          REAL AVOLT(10),BVOLT(10),RPRES(10),DMM(10)
0478          INTEGER NOCR(2),ICLR(3),ITIME(5),IO(5)
0479
0480          DATA NOLF  /006537B/
0481          DATA NOCR  /000033B,040433B/
0482          DATA ICLR  /015524B,015515B,006537B/
0483
0484    C     FORMATS CALIB START
0485      101 FORMAT (/" "79X""A2/"  Apply defined reference pressur
0486         *e to KULITE pressure transducers!  Input DMM   "A2/
0487         *"  multimeter read out to initialize calibration,  RE
0488         *to repeat this part of the "A2/
0489         *"  calibration  or  EN to terminate the on line calibr
0490         *ation!"21X""A2/" "79X""/
0491         *"                "A2)
0492      102 FORMAT (5A2)
0493      103 FORMAT (F10.6)
0494      104 FORMAT ("  CALIB : CALL FREER")
0495      105 FORMAT ("  Switch PACER to free run mode;  then press
0496         *CR to continue!  "3A2)
0497      106 FORMAT ("  Switch PACER to pacer run mode;  then press
0498         * CR to continue! "3A2)
0499      107 FORMAT ("  CALIB : CALL PACER("I2")")
0500      108 FORMAT ("  Error: You did not perform a calibration at all
0501         *!"30X""A2)
0502      109 FORMAT ("  Error: Please, ask yourself honestly, whether j
0503         *ust one point is sufficient"4X""A2/
0504         *"  to give an accurate calibration curve fit?  I frankly doubt
0505         * it!"15X""A2)
0506      149 FORMAT ((3A2))
0507
0508      601 FORMAT (1H ,15(1H ),33HTranssonic Compressor Test Run # ,I7)
0509      602 FORMAT (1H ,28(1H ),6HDate:  ,A2,1H/,A2,1H/,A2)
0510      603 FORMAT (1H ,"",28(1H ),6HTime:  ,A2,1H.,A2,3H  h,/////)
0511      604 FORMAT (1H ,"",/////,8X
0512         *,"  On line Calibration Page "I2" .  "
0513         */////)
0514      605 FORMAT (/"   "I1", reference pressure applied"/)
0515      606 FORMAT (/"   Calibration done;  take paced run data",
0516         *"")/)
0517      607 FORMAT (//1X"Calibration results : "/)
0518      608 FORMAT (1X"AVOLT("I1")="F8.6"   BVOLT("I1")="F8.6"   RPRES("I1")="
0519         *F8.6"   DMM("I1")="F8.6)
0520      609 FORMAT (/1X"Type  A  Probe : "//
0521         *1X"SLOPE ="F10.6"   SECON ="F10.6/)
0522      610 FORMAT (/1X"Type  B  Probe : "//
0523         *1X"SLOPE ="F10.6"   SECON ="F10.6/)
0524      611 FORMAT ("
```

",28(1H),6HTime: ,A2,1H.,A2,3H h)

```
0525  C     FORMATS CALLED STOP
0526
0527
0528
0529  C     .....................................................
0530  CCC   .                                                   .
0531  CCC   .  Accounting.                                     .
0532  C     .                                                   .
```

```
0533   C     .....................................................................
0534         IPAGE       = CNTRL(214)
0535         IPAGE       = IPAGE+1
0536
0537
0538
0539   C     .....................................................................
0540   CC    .                                                                   .
0541   C     .  I/O Assignments;  print heading.                                 .
0542   CC    .                                                                   .
0543   C     .....................................................................
0544         LI = CNTRL(19)
0545         LO = CNTRL(20)
0546         CALL TIME (IMON,IDAY,IYEAR,IHOUR,IMIN)
0547         WRITE (LO, 601) CNTRL(4)
0548         WRITE (LO, 602) IMON,IDAY,IYEAR
0549         WRITE (LO, 603) IHOUR,IMIN
0550         WRITE (LO, 604) IPAGE
0551         IPTS = 0
0552
0553
0554
0555   C     .....................................................................
0556   CC    .                                                                   .
0557   C     .  Limit on line calibration calibration to two A/D channels,       .
0558   C     .  that contain the type 'A' and 'B' probe output voltage.          .
0559   C     .  The current value of CNTRL(230) is temporaryly stored in         .
0560   C     .  the variable ITEMP.                                              .
0561   CC    .                                                                   .
0562   C     .....................................................................
0563         IPREV = CNTRL(230)
0564         CNTRL(230) = 2
0565
0566
0567
0568   C       ...................................................................
0569   CC      .                                                                 .
0570   C       .  Select the next step:                                          .
0571   C       .    RE                 Repeat this point                       .
0572   C       .    EN                 Terminate the on line calibration       .
0573   C       .    any number         Proceed to the next point               .
0574   CC      .                                                                 .
0575   C       ...................................................................
0576      01   WRITE (LI, 101) (NOLF,I=1,5,1)
0577           READ  (LI, 102) IO
0578           WRITE (LI, 149) (ICLR,I=1,8,1)
0579           IF ( IO(1)  .EQ.  2HRE ) GO TO 01
0580           IF ( IO(1)  .EQ.  2HEN ) GO TO 10
0581           IF ( IO(1)  .EQ.  2H$$ ) STOP 0201
0582           IDUM = 0
0583           DO 02 I=1,5,1
0584      02   IF ( IO(I)  .NE.  2H   ) IDUM = 1
0585           IF ( IDUM   .EQ.  0    ) GO TO 01
0586           CALL CODE
0587           READ (IO, 103) DM
0588
0589
0590
0591   C       ...................................................................
0592   CC      .                                                                 .
0593   C       .  Take free run data at a defined reference pressure.            .
0594   CC      .                                                                 .
0595   C       ...................................................................
0596      03   IPTS = IPTS+1
0597           DMM(IPTS) = DM
0598      04   WRITE (LI, 104)
0599           WRITE (LI, 105) NOCR
0600           READ  (LI, 102) IDUM
0601           WRITE (LI, 149) ICLR
0602           IF ( IDUM  .EQ.  2H$$ ) STOP 0202
0603           CNTRL(37) = 1
0604           CNTRL(38) = IPTS
0605           WRITE (LO, 605) IPTS
0606           CALL FREER (AVOLT(IPTS),BVOLT(IPTS),RPRES(IPTS))
0607
```

```
0608
0609
0610   C     .....................................................................
0611   C     .                                                                   .
0612   C     .  Select the next step:                                            .
0613   C     .    RE                  Repeat this point                          .
0614   C     .    EN                  Terminate the on line calibration          .
0615   C     .    any number          Proceed to the next point                  .
0616   C     .                                                                   .
0617   C     .....................................................................
0618        05   WRITE (LI, 101) (NOLF,I=1,5,1)
0619             READ  (LI, 102) IO
0620             WRITE (LI, 149) (ICLR,I=1,8,1)
0621             IF ( IO(1)  .EQ.  2HRE ) GO TO 04
0622             IF ( IO(1)  .EQ.  2HEN ) GO TO 07
0623             IF ( IO(1)  .EQ.  2H$$ ) STOP 0203
0624             IDUM = 0
0625             DO 06 I=1,5,1
0626        06   IF ( IO(I)  .NE.  2H   ) IDUM = 1
0627             IF ( IDUM   .EQ.  0    ) GO TO 05
0628             CALL CODE
0629             READ (IO,103) DM
0630             GO TO 03
0631
0632
0633
0634   C     .....................................................................
0635   C     .                                                                   .
0636   C     .  Take paced run data at one defined reference pressure.           .
0637   C     .                                                                   .
0638   C     .....................................................................
0639        07 IF ( IPTS .EQ. 1 ) GO TO 11
0640           CNTRL(37) = 1
0641           CNTRL(38) = 1
0642           WRITE (LI, 106) NOCR
0643           READ  (LI, 102) IDUM
0644           WRITE (LI, 149) ICLR
0645           IF ( IDUM .EQ.  2H$$ ) STOP 0204
0646           IREC      = 1
0647           WRITE (LI, 107) IREC
0648           WRITE (LO, 606)
0649           CALL PACER (IREC)
0650
0651
0652
0653   C     .....................................................................
0654   C     .                                                                   .
0655   C     .  Calculate linear curve fit through data points.                  .
0656   C     .                                                                   .
0657   C     .....................................................................
0658           WRITE (LO, 607)
0659           DO 08 I=1,IPTS,1
0660        08 WRITE (LO, 608) I,AVOLT(I),I,BVOLT(I),I,RPRES(I),I,DMM(I)
0661           CALL CURVE (IPTS,AVOLT,RPRES,SLOPE,SECON)
0662           WRITE (LO, 609) SLOPE,SECON
0663           CALL CURVE (IPTS,BVOLT,RPRES,SLOPE,SECON)
0664           WRITE (LO, 610) SLOPE,SECON
0665
0666
0667   C     .....................................................................
0668   C     .                                                                   .
0669   C     .  Terminate subroutine;  write accounting variables back into      .
0670   C     .  control array;  set CNTRL(230) back to its previous value.       .
0671   C     .                                                                   .
0672   C     .....................................................................
0673        09 CNTRL( 37) = -1
0674           CNTRL( 38) = 1
0675           CNTRL( 50) = -2
0676           CNTRL(214) = IPAGE
0677           CNTRL(230) = IPREV
0678           CALL TIME (IMON,IDAY,IYEAR,IHOUR,IMIN)
0679           WRITE (LO, 611) IHOUR,IMIN
0680           RETURN
0681
0682
```

```
0683
0684   C     .....................................................................
0685   CC    .                                                                   .
0686   CC    .  Error returns.                                                   .
0687   CC    .                                                                   .
0688   C     .....................................................................
0689        10 WRITE (LI, 108) NOLF
0690           GO TO 09
0691        11 WRITE (LI, 109) (NOLF,I=1,2,1)
0692           GO TO 09
0693
0694
0695
0696           END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 01525 COMMON = 00000

```
0697          SUBROUTINE FREER (AVOLT,BVOLT,PREFR)
0698    C     .....................................................................
0699    C     .                                                                   .
0700    C     .  Subroutine to acquire data using the HP 5610A A/D converter,     .
0701    C     .  if the A/D converter is operated in free run mode.               .
0702    C     .  Author:     Hans Zebner                                          .
0703    C     .  Date:       August 14, 1980                                      .
0704    C     .  A detailed program description is available in the TXCO log.     .
0705    C     .  Comment statements and statement numbers in the source code      .
0706    C     .  match to the program description.  This subroutine is part of    .
0707    C     .  the TXCO transonic compressor investigation program system.      .
0708    C     .                                                                   .
0709    C     .....................................................................
0710         *, Takes data from KULITE probes; A/D free run mode.
0711
0712          COMMON / CIBUF / IBUF
0713          COMMON / CONTR / CNTRL
0714          COMMON / FMP   / IDCB,IFILE,ISIZE,ISECU,ICR
0715
0716          INTEGER IBUF(1664)
0717          INTEGER CNTRL(256)
0718          INTEGER IDCB(144),IFILE(3),ISIZE(2)
0719
0720          INTEGER NOLF,NOCR(2),ICLR(3),IOXIM(9)
0721
0722          DATA NOLF  /006537B/
0723          DATA NOCR  /000033B,040433B/
0724          DATA ICLR  /015524B,015515B,006537B/
0725          DATA FSVLT /1.00/
0726          DATA IDCBS /1441/
0727    C     FORMATS FREER START
0728      101 FORMAT (""27X"acquiring additional data"27X""A2)
0729      102 FORMAT ("B "F7.6,F9.6)
0730      103 FORMAT ("A "F7.6,F9.6)
0731      104 FORMAT (18H       Wall KULITE)
0732      105 FORMAT (""28X"acquiring data from A/D"28X""A2)
0733      106 FORMAT (""24X"calculating the average voltage"24X""A2)
0734      107 FORMAT (""26X"storing data in file "3A2,26X""A2)
0735      108 FORMAT ("WARNING: file "3A2" already exists!  Type PU to "
0736         *"allow purge or enter any char-",
0737         */,"           acter but T to change file name."38X)
0738      109 FORMAT ("  FREER : PURGE "3A2":"A2":"A2)
0739      110 FORMAT (A1"2")
0740      111 FORMAT ("  FREER : File name "3A2" succesfully changed to "3A2)
0741      148 FORMAT (/3A2)
0742      149 FORMAT ((3A2))
0743
0744      601 FORMAT (1H ,15(1H ),33HTranssonic Compressor Test Run # ,I7)
0745      602 FORMAT (1H ,28(1H ),6HDate: ,A2,1H/,A2,1H/,A2)
0746      603 FORMAT (1H ,"",28(1H ),6HTime: ,A2,1H.,A2,3H  h,/////)
0747      604 FORMAT (1H ,"",/////,8X
0748         *,"  Free Run Page "I3" .  "
0749         */////)
0750      605 FORMAT (/1X""72X""/1X""72X""/
0751         *          1X"          A/D input
0752         *                        "/
0753         *          1X" # sample  channel
0754         *              # points"/1X""72X""/
0755         *          1X"Combination probe:"54X""/
0756         *          1X"immersion   yaw a.       p1       p23       p4
0757         *  Tt        dT          "/1X""72X""/
0758         *          1X"KULITE probe:     reference    rotor  average
0759         *            starting"/
0760         *          1X"immersion   yaw a. pressure      RPM  voltage
0761         * data in file record #"/1X""72X""/)
0762      606 FORMAT (1H )
0763      607 FORMAT (1X""72X""/1X""2I9,45X,I9""/1X""7F9.6,"
0764         *"9X""/1X""9A2,F9.6,I9,F9.6,6X,3A2":"A2":"A2,I9""/
0765         *1X""72X"")
0766      608 FORMAT ("
```

",28(1H),6HTime: ,A2,1H.,A2,3H h)

```
0767     901 FORMAT (" ERROR DETECTED IN PROGRAM FREER"/
0768    *            " CALL EXEC (1,20,IBUF(1),"I4","I2",4)")
0769     902 FORMAT (" A REGISTER IS "K6"       B REGISTER IS "K6/)
0770   C     FORMATS FREER STOP
0771
```

```
0772
0773
0774   C      .....................................................................
0775   CC     .                                                                   .
0776   CC     .  Accounting.                                                      .
0777   CC     .                                                                   .
0778   C      .....................................................................
0779          IPAGE     = CNTRL(216)
0780          IDOC      = CNTRL(217)
0781          IDOCF     = CNTRL(217)
0782          IPAGE     = IPAGE+1
0783          ISECU     = CNTRL(31)
0784          ICR       = CNTRL(30)
0785          ISIZE(1)  = 13
0786          ISIZE(2)  = 128
0787          IFILE(2)  = ICON(CNTRL(4),0)
0788          ITYPE     = 1
0789          IFRST     = 2HT2
0790          ISP       = 0
0791          IL        = 1664
0792
0793
0794
0795   C      .....................................................................
0796   CC     .                                                                   .
0797   CC     .  I/O Assignments;  preset data array.                            .
0798   CC     .                                                                   .
0799   C      .....................................................................
0800          DO 01 I=1,1664,1
0801       01 IBUF(I)   = 177777B
0802          LI        = CNTRL(19)
0803          LO        = CNTRL(20)
0804          LS1       = CNTRL(71)
0805          LS2       = CNTRL(72)
0806          ISV1      = CNTRL(61)
0807          ISV4      = CNTRL(64)
0808          NRPT1     = CNTRL(230)
0809          NRPT2     = CNTRL(251)
0810          NRPT3     = NRPT2+1
0811          IMASK     = 177700B
0812          IW        = CNTRL(250)
0813
0814
0815
0816   C      .....................................................................
0817   CC     .                                                                   .
0818   CC     .  Print heading, unless CNTRL(37) is set to 1.                    .
0819   CC     .                                                                   .
0820   C      .....................................................................
0821          IF ( CNTRL(37)  .EQ.  1 ) GO TO 02
0822          CALL TIME (IMON,IDAY,IYEAR,IHOUR,IMIN)
0823          WRITE (LO, 601) CNTRL(4)
0824          WRITE (LO, 602) IMON,IDAY,IYEAR
0825          WRITE (LO, 603) IHOUR,IMIN
0826          WRITE (LO, 604) IPAGE
0827       02 IF ( CNTRL(38)  .EQ.  1 ) WRITE (LO, 605)
0828
0829
0830
0831   C        .....................................................................
0832   CC       .                                                                   .
0833   CC       .  Start data acquisition loop.                                    .
0834   CC       .                                                                   .
0835   C        .....................................................................
0836            DO 19 J1=1,NRPT1,1
0837            WRITE (LI, 101) NOLF
0838            ICHNL = CNTRL(230+J1)
0839            IDOC  = IDOC+1
0840            IDOCF = IDOCF+1
0841            IF ( IDOCF  .LT.  100 ) GO TO 03
0842            IFRST     = 2HS2
0843            IDOCF     = IDOCF-100
0844       03   IFILE(1)  = IFRST
0845            IFILE(3)  = ICON(IDOCF,0)
0846
```

```
0847
0848
0849   C     .....................................................................
0850   CC    .                                                                   .
0851   CC    .  Acquire additional data required for reduction procedure.        .
0852   CC    .                                                                   .
0853   C     .....................................................................
0854         FREQ  = SCANR(LS1,17,2)
0855         FREQ  = FREQ*10.0
0856         CIM   = SCANR(LS1,30,1)
0857         CYAW  = SCANR(LS1,31,1)
0858         PREF  = SCANR(LS1,37,1)
0859         PREFR = PREF
0860         P1    = ACQN(ISV4, 3,IW)
0861         P23   = ACQN(ISV4, 4,IW)
0862         P4    = ACQN(ISV4, 5,IW)
0863         E     = SCANR(LS2,18,1)
0864         DE    = SCANR(LS2,19,1)
0865
0866
0867
0868   C     .....................................................................
0869   CC    .                                                                   .
0870   CC    .  Get correct probe positions.                                     .
0871   CC    .                                                                   .
0872   C     .....................................................................
0873         IF ( ICHNL .EQ.  0 ) GO TO 04
0874         IF ( ICHNL .EQ.  1 ) GO TO 05
0875         GO TO 06
0876
0877
0878
0879   C     .....................................................................
0880   CC    .                                                                   .
0881   CC    .  Type 'A' KULITE probe (on A/D input channel 0).                  .
0882   CC    .                                                                   .
0883   C     .....................................................................
0884     04  XIM   = SCANR(LS1,32,1)
0885         YAW   = SCANR(LS1,33,1)
0886         CALL CODE
0887         WRITE (IOXIM,102) XIM,YAW
0888         GO TO 07
0889
0890
0891
0892   C     .....................................................................
0893   CC    .                                                                   .
0894   CC    .  Type 'B' KULITE probe (on A/D input channel 1).                  .
0895   CC    .                                                                   .
0896   C     .....................................................................
0897     05  XIM   = SCANR(LS1,34,1)
0898         YAW   = SCANR(LS1,35,1)
0899         CALL CODE
0900         WRITE (IOXIM,103) XIM,YAW
0901         GO TO 07
0902
0903
0904
0905   C     .....................................................................
0906   CC    .                                                                   .
0907   CC    .  Wall KULITE (on A/D input channels 2 and higher).                .
0908   CC    .                                                                   .
0909   C     .....................................................................
0910     06  CALL CODE
0911         WRITE (IOXIM,104)
0912
0913
0914
0915   C       ...................................................................
0916   CC      .                                                                 .
0917   CC      .  Preset unused elements of data array IBUF.                     .
0918   CC      .                                                                 .
0919   C       ...................................................................
0920     07    IF ( NRPT2 .EQ. 1664 ) GO TO 09
0921           DO 08 J2=NRPT3,1664,1
```

```
0922      08     IBUF(J2) = 000000B
0923
0924
0925
0926   C         .....................................................
0927   C         .
0928   C         .  Read voltages from A/D converter into data array IBUF;
0929   C         .  Starting element is IBUF(1);  A/D is operated in the
0930   C         .  free run mode (4).
0931   C         .
0932   C         .....................................................
0933      09     WRITE (LI, 105) NOLF
0934             CALL EXEC (1+100000B,20,IBUF(1),NRPT2,ICHNL,4)
0935             GO TO 11
0936      10     GO TO 12
0937      11     CALL ABREG (IA,IB)
0938             GO TO 21
0939
0940
0941
0942   C         .....................................................
0943   C         .
0944   C         .  Calculate average voltage.
0945   C         .
0946   C         .....................................................
0947      12     WRITE (LI, 106) NOLF
0948             DO 13 J2=1,NRPT2,1
0949      13     IBUF(J2)=IAND(IBUF(J2),IMASK)
0950             AVRGE = 0.0
0951             DO 14 J2=1,NRPT2,1
0952      14     AVRGE = AVRGE+FLOAT(IBUF(J2))
0953             AVRGE = FSVLT*((AVRGE/32768.0)/NRPT2)
0954
0955
0956
0957   C         .....................................................
0958   C         .
0959   C         .  Write average KULITE voltage (after amplification and
0960   C         .  conversion to digital notation) into AVOLT and BVOLT, de-
0961   C         .  pending on what signal has been digitized;  The type 'A'
0962   C         .  probe is on A/D input channel 0 and the type 'B' on 1.
0963   C         .
0964   C         .....................................................
0965             IF ( ICHNL  .EQ.  0 ) AVOLT = AVRGE
0966             IF ( ICHNL  .EQ.  1 ) BVOLT = AVRGE
0967
0968
0969
0970           IF ( ISP  .LT.  5 ) GO TO 15
0971           ISP   = 0
0972           IF ( CNTRL( 37)  .NE.  1 ) WRITE (LO, 606)
0973      15   ISP   = 1+ISP
0974
0975
0976
0977   C       .....................................................
0978   C       .
0979   C       .  Save data in file.
0980   C       .
0981   C       .....................................................
0982      16   WRITE (LI, 107) IFILE,NOLF
0983           CALL CREAT (IDCB,IERR,IFILE,ISIZE,ITYPE,ISECU,ICR,IDCBS)
0984           IF ( IERR  .GT.  0 ) GO TO 18
0985           WRITE (LI, 108) IFILE
0986           READ  (LI, 149) IDUM
0987           WRITE (LI, 149) (ICLR,I=1,3,1)
0988           IF ( IDUM  .EQ.  2H$$ ) STOP 0301
0989           IF ( IDUM  .NE.  2HPU ) GO TO 17
0990           JSECU = ICON(ISECU,0)
0991           JCR   = ICON(ICR,0)
0992           WRITE (LI, 109) IFILE,JSECU,JCR
0993           CALL PURGE (IDCB,IERR,IFILE,ISECU,ICR)
0994           IF ( IERR  .LT.  0 ) STOP 0302
0995           GO TO 16
0996      17   CALL CODE
```

```
0997            WRITE (NEW,110) IDUM
0998            WRITE (LI, 111) IFILE,NEW,IFILE(1),IFILE(2)
0999            IFILE(1) = NEW
1000            GO TO 16
1001       18   CALL OPEN  (IDCB,IERR,IFILE,IOPTN,ISECU,ICR,IDCBS)
1002            IF ( IERR  .LT.  0 ) STOP 0303
1003            CALL WRITF (IDCB,IERR,IBUF,IL)
1004            IF ( IERR  .LT.  0 ) STOP 0304
1005            CALL CLOSE (IDCB,IERR,0)
1006            IF ( IERR  .LT.  0 ) STOP 0305
1007            WRITE (LI, 148) ICLR
1008            JSECU = ICON(ISECU,0)
1009            JCR   = ICON(ICR,0)
1010
1011
1012
1013  C         .....................................................................
1014  CC        .                                                                   .
1015  CC        .  Stop data acquisition loop.                                      .
1016  CC        .                                                                   .
1017  C         .....................................................................
1018       19   WRITE (LO, 607) IDOC,ICHNL,NRPT2,CIM,CYAW,P1,P23,P4,E,DE,IOXIM,P
1019         *   REF,FREQ,AVRGE,IFILE,JSECU,JCR,IREC
1020
1021
1022
1023  C         .....................................................................
1024  CC        .                                                                   .
1025  CC        .  Terminate subroutine;  write accounting variables back          .
1026  CC        .  into control array.                                              .
1027  CC        .                                                                   .
1028  C         .....................................................................
1029            IF ( CNTRL(37)  .EQ.  1 ) GO TO 20
1030            CALL TIME (IMON,IDAY,IYEAR,IHOUR,IMIN)
1031            WRITE (LO, 608) IHOUR,IMIN
1032       20   CNTRL( 37) = -3
1033            CNTRL( 38) = 1
1034            CNTRL( 50) = -3
1035            CNTRL(216) = IPAGE
1036            CNTRL(217) = IDOC
1037            RETURN
1038
1039
1040
1041  C         .....................................................................
1042  CC        .                                                                   .
1043  CC        .  Error returns from EXEC calls;  output error message to the     .
1044  CC        .  line printer and look what's in the A and B register.            .
1045  CC        .                                                                   .
1046  C         .....................................................................
1047       21   WRITE ( 6, 901) NRPT2,ICHNL
1048            WRITE ( 6, 902) IA,IB
1049            GO TO 20
1050
1051
1052
1053            END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 01829 COMMON = 00000

```
1054          SUBROUTINE PACER (IREC)
1055    C     ......................................................................
1056    C     .                                                                    .
1057    C     .  Subroutine to acquire data using the HP 5610A A/D converter,      .
1058    C     .  if the A/D converter is triggered through the pacer (paced        .
1059    C     .  run mode).                                                        .
1060    C     .  Author:     Hans Zebner                                           .
1061    C     .  Date:       August 25, 1980                                       .
1062    C     .  A detailed program description is available in the TXCO log.      .
1063    C     .  Comment statements and statement numbers in the source code       .
1064    C     .  match to the program description.  This subroutine is part of     .
1065    C     .  the TXCO transonic compressor investigation program system.       .
1066    C     .                                                                    .
1067    C     ......................................................................
1068          *, Takes data from KULITE probes; A/D paced run mode.

1069          COMMON / CIBUF / IBUF
1070          COMMON / CONTR / CNTRL
1071          COMMON / FMP   / IDCB,IFILE,ISIZE,ISECU,ICR
1072
1073          INTEGER IBUF(1664)
1074          INTEGER CNTRL(256)
1075          INTEGER IDCB(144),IFILE(3),ISIZE(2)
1076
1077          INTEGER NOLF,NOCR(2),ICLR(3),IBUF1(384),IOXIM(9),IAVRGE(2)
1078
1079          EQUIVALENCE (IBUF(1),IBUF1(1)),(IAVRGE(1),AVRGE)
1080
1081          DATA NOLF  /006537B/
1082          DATA NOCR  /0000338,040433B/
1083          DATA ICLR  /015524B,015515B,006537B/
1084          DATA IDCBS /1441
1085    C     FORMATS  PACER  START
1086      101 FORMAT (""11X"acquiring additional data required for reductio"
1087         *"n procedure"10X""A2)
1088      102 FORMAT ("A"F8.6,F9.6)
1089      103 FORMAT ("B"F8.6,F9.6)
1090      104 FORMAT (18H          Wall KULITE)
1091      105 FORMAT (""/""79X""/" The next signal to be digitized
1092         * in paced run mode is on A/D input channel"I3". "/
1093         *" Plug in a lead from the amplifier output to the oscilloscope
1094         *, if you desire    "/
1095         *" to monitor the data acquisition.  Don't forget the c
1096         *omparator output signal!  "/""79X""/
1097         *" Press CR to continue the program execution!"35X"
1098         *"/""79X""/)
1099      106 FORMAT (""21X"displaying wave form on terminal LU#"I2,20X"
1100         *"A2)
1101      107 FORMAT (""/""79X""/" CHECK digitized output on a
1102         *uxiliary console against amplifier output fed into "/
1103         *" A/D input channel "I2" .  Press CR if data a
1104         *re OK.  If an error is suspected    "/
1105         *" type RE to repeat this data acquisition!"38X""/
1106         *""79X""/)
1107      108 FORMAT (""26X"storing data in file "3A2,26X""A2)
1108      109 FORMAT ("WARNING: File "3A2" already exists!  Type ",
1109         *"PU to allow purge or enter any char-",
1110         */," "          acter but T to change file name."38X)
1111      110 FORMAT ("  PACER : PURGE "3A2":"A2":"A2)
1112      111 FORMAT (A1"3")
1113      112 FORMAT ("  PACER : File name "3A2" succesfully changed to "3A2)
1114      113 FORMAT (I5,A2)
1115      148 FORMAT ((/3A2))
1116      149 FORMAT (3A2)
1117      601 FORMAT (1H ,15(1H ),33HTranssonic Compressor Test Run # ,I7)
1118      602 FORMAT (1H ,28(1H ),6HDate: ,A2,1H/,A2,1H/,A2)
1119      603 FORMAT (1H ,"",28(1H ),6HTime: ,A2,1H.,A2,3H  h,/////)
1120      604 FORMAT (1H ,"",/////,8X
1121         *,"  Paced Run Page "I3" .  "
1122         *//////)
1123      605 FORMAT (/1X""72X""/1X""72X""/
1124         *          1X"          A/D input    pacer    blade    start   in
1125         *cre-      stop  # repe-"/
1126         *          1X" # sample  channel     mode     pair     count
1127         *ment     count  titions"/1X""72X""/
1128         *          1X"Combination probe:"54X""/
```

```
1129        *           1X"Immersion   yaw a.       pi      p23       p4
1130        *  Tt         dT          "/1X""72X""/
1131        *           1X"Probe            reference    rotor  average
1132        *              starting"/
1133        *           1X"Immersion   yaw a. pressure      RPM  voltage
1134        * data in file record #"/1X""72X""/)
1135      609 FORMAT (1H )
1136      610 FORMAT (1X""72X""/1X""8I9""/1X""7F9.6,9X""
1137         */" "9A2,F9.6,I9,F9.6,6X,3A2":"A2":"A2,I9""/" "72X"
1138         *")
1139      611 FORMAT ("
```

```
*,28(1H ),6HTime: ,A2,1H.,A2,3H  h)
```

```
1140   C      FORMATS PACER STOP
1141
1142
1143
1144   C      .....................................................................
1145   CC     .                                                                   .
1146   CC     .  Accounting.                                                      .
1147   CC     .                                                                   .
1148   C      .....................................................................
1149          IF ( CNTRL(39)  .EQ.  1 ) GO TO 01
1150          IPAGE     = CNTRL(218)
1151          IDOC      = CNTRL(219)
1152          IDOCF     = CNTRL(219)
1153          IPAGE     = IPAGE+1
1154          ISECU     = CNTRL(31)
1155          ICR       = CNTRL(30)
1156          ISIZE(1)  = 3
1157          ISIZE(2)  = 128
1158          IFILE(2)  = ICON(CNTRL(4),0)
1159          ITYPE     = 1
1160          IFRST     = 2HT3
1161       01 ISP       = 0
1162          IL        = 384
1163
1164
1165
1166   C      .....................................................................
1167   CC     .                                                                   .
1168   CC     .  I/O Assignments;  preset data array.                             .
1169   CC     .                                                                   .
1170   C      .....................................................................
1171          DO 02 I=1,384,1
1172       02 IBUF1(I) = 177777B
1173          DO 03 I=265,296,1
1174       03 IBUF1(I) = 0
1175          LI        = CNTRL(19)
1176          LO        = CNTRL(20)
1177          LA        = CNTRL(21)
1178          LS1       = CNTRL(71)
1179          LS2       = CNTRL(72)
1180          ISV1      = CNTRL(61)
1181          ISV4      = CNTRL(64)
1182          NRPT1     = CNTRL(230)
1183          IW        = CNTRL(250)
1184
1185
1186
1187   C      .....................................................................
1188   CC     .                                                                   .
1189   CC     .  Print heading, unless CNTRL(37) is set to 1.                     .
1190   C      .                                                                   .
1191   C      .....................................................................
1192          IF ( CNTRL(37)  .EQ.  1 ) GO TO 04
1193          CALL TIME (IMON,IDAY,IYEAR,IHOUR,IMIN)
1194          WRITE (LO, 601) CNTRL(4)
1195          WRITE (LO, 602) IMON,IDAY,IYEAR
1196          WRITE (LO, 603) IHOUR,IMIN
1197          WRITE (LO, 604) IPAGE
1198       04 IF ( CNTRL(38)  .EQ.  1 ) WRITE (LO, 605)
1199
1200
1201
1202   C      .....................................................................
1203   C      .                                                                   .
```

```
1204  C        :  Start data acquisition loop.                              :
1205  C        :                                                            :
1206  C        ..............................................................
1207           DO 19 Ji=i,NRPTi,i
1208           WRITE (LI, 101) NOLF
1209           ICHNL = CNTRL(230+Ji)
1210           IF ( CNTRL(39)   .EQ.  1 ) GO TO 06
1211           IDOC  = IDOC+1
1212           IDOCF = IDOCF+1
1213           IF ( IDOCF   .LT.  100 ) GO TO 05
1214           IFRST    = 2HS3
1215           IDOCF = IDOCF-100
1216      05   IFILE(1) = IFRST
1217           IFILE(3) = ICON(IDOCF,0)
1218
1219
1220
1221  C        ..............................................................
1222  CC       :                                                            :
1223  CC       :  Acquire additional data required for reduction procedure. :
1224  CC       :                                                            :
1225  C        ..............................................................
1226      06   FREQ  = SCANR(LS1,17,2)
1227           FREQ  = FREQ*10.0
1228           CIM   = SCANR(LS1,30,1)
1229           CYAW  = SCANR(LS1,31,1)
1230           PREF  = SCANR(LS1,37,1)
1231
1232           P1    = ACQN(ISV4, 3,IW)
1233           P23   = ACQN(ISV4, 4,IW)
1234           P4    = ACQN(ISV4, 5,IW)
1235           E     = SCANR(LS2,18,1)
1236           DE    = SCANR(LS2,19,1)
1237
1238
1239
1240  C        ..............................................................
1241  CCCC     :                                                            :
1242  CCCC     :  Get correct probe positions.                              :
1243  CCCC     :                                                            :
1244  C        ..............................................................
1245           IF ( ICHNL   .EQ.  0 ) GO TO 07
1246           IF ( ICHNL   .EQ.  1 ) GO TO 08
1247           GO TO 09
1248
1249
1250
1251  C        ..............................................................
1252  CCCC     :                                                            :
1253  CCCC     :  Type 'A' KULITE probe (on A/D input channel 0).           :
1254  CCCC     :                                                            :
1255  C        ..............................................................
1256      07   XIM   = SCANR(LS1,32,1)
1257           YAW   = SCANR(LS1,33,1)
1258           CALL CODE
1259           WRITE (IOXIM,102) XIM,YAW
1260           IADD = 0
1261           IBUF1(280) = 1
1262           GO TO 10
1263
1264
1265
1266  C        ..............................................................
1267  CCCC     :                                                            :
1268  CCCC     :  Type 'B' KULITE probe (on A/D input channel 1).           :
1269  CCCC     :                                                            :
1270  C        ..............................................................
1271      08   XIM   = SCANR(LS1,34,1)
1272           YAW   = SCANR(LS1,35,1)
1273           CALL CODE
1274           WRITE (IOXIM,103) XIM,YAW
1275           IADD = 576
1276           IBUF1(280) = 2
1277           GO TO 10
1278
```

```
1279
1280
1281   C     .....................................................................
1282   C     .                                                                   .
1283   C     .  Wall KULITE (on A/D input channels 2 and higher).                .
1284   C     .                                                                   .
1285   C     .....................................................................
1286      09    CALL CODE
1287            WRITE (IOXIM,104)
1288            IBUF1(280) = 9
1289            XIM = -99.
1290            YAW = -99.
1291
1292
1293
1294   C     .....................................................................
1295   C     .                                                                   .
1296   C     .  Inform operator about next data scan;  wait for ready            .
1297   C     .  message;  continue.                                              .
1298   C     .                                                                   .
1299   C     .....................................................................
1300      10    WRITE (LI, 105) ICHNL
1301            READ  (LI, 149) IDUM
1302            WRITE (LI, 149) (ICLR,I=1,10,1)
1303            IF ( IDUM .EQ.  2H$$ ) STOP 0401
1304
1305
1306
1307   C     .....................................................................
1308   C     .                                                                   .
1309   C     .  Acquire high speed data in paced run mode.                       .
1310   C     .                                                                   .
1311   C     .....................................................................
1312            IPAMO = CNTRL(220)
1313            IPAIR = CNTRL(221)
1314            IF ( IPAMO  .EQ.  2 ) ISTART = CNTRL(222)+IADD
1315            IF ( IPAMO  .EQ.  2 ) ISTOP  = CNTRL(224)+IADD
1316            INCR  = CNTRL(223)
1317            IRPT  = CNTRL(225)
1318            CALL RPACE (ICHNL,IPAMO,IPAIR,ISTART,INCR,ISTOP,IRPT,AVRGE,0,0)
1319
1320
1321
1322   C     .....................................................................
1323   C     .                                                                   .
1324   C     .  Write additional data into data array.                           .
1325   C     .                                                                   .
1326   C     .....................................................................
1327            IBUF1(265) = IDOC
1328            IBUF1(266) = ICHNL
1329            IBUF1(267) = IPAMO
1330            IBUF1(268) = IPAIR
1331            IBUF1(269) = ISTART
1332            IBUF1(270) = INCR
1333            IBUF1(271) = ISTOP
1334            IBUF1(272) = IRPT
1335
1336            IBUF1(273) = CIM  * 1000000.
1337            IBUF1(274) = CYAW * 1000000.
1338            IBUF1(275) = P1   * 1000000.
1339            IBUF1(276) = P23  * 1000000.
1340            IBUF1(277) = P4   * 1000000.
1341            IBUF1(278) = E    * 1000000.
1342            IBUF1(279) = DE   * 1000000.
1343
1344            IBUF1(281) = XIM  * 1000000.
1345            IBUF1(282) = YAW  * 1000000.
1346            IBUF1(283) = PREF * 1000000.
1347            IBUF1(284) = RPM
1348
1349            IBUF1(290) = CNTRL(4)
1350            IBUF1(291) = CNTRL(5)
1351            IBUF1(292) = CNTRL(6)
1352
1353            IBUF1(293) = IAVRGE(1)
```

```
1354            IBUF1(294) = IAVRGE(2)
1355
1356            CALL TIME (IBUF1(352),IBUF1(360),IBUF1(368),IBUF1(376),IBUF1(384
1357          *  ))
1358
1359
1360
1361    C       .....................................................................
1362    CC      .                                                                   .
1363    CC      .  Display the just acquired wave on terminal CRT, if               .
1364    CC      .  CNTRL(40) is set to 1.  The character used for the "plot"        .
1365    CC      .  is defined by CNTRL(249).                                        .
1366    CC      .                                                                   .
1367    C       .....................................................................
1368            WRITE (LI, 148) ICLR
1369            WRITE (LI, 149) ICLR
1370            IF ( CNTRL(40)  .NE.  1 ) GO TO 11
1371            WRITE (LI, 106) LA,NOLF
1372            J111 = 1
1373            J222 = 1
1374            CALL PICTR (LA,IDOC,J111,J222,CNTRL(249),DUM)
1375
1376
1377
1378    C       .....................................................................
1379    CC      .                                                                   .
1380    CC      .  Select the next step:                                            .
1381    CC      .     RE              Repeat this point                             .
1382    CC      .     anything else   Proceed to the next point                     .
1383    CC      .                                                                   .
1384    C       .....................................................................
1385            WRITE (LI, 107) ICHNL
1386            READ  (LI, 149) IDUM
1387            WRITE (LI, 149) (ICLR,I=1,8,1)
1388            IF ( IDUM  .EQ.  2H$$ ) STOP 0402
1389            IF ( IDUM  .EQ.  2HRE ) GO TO 06
1390
1391        11  IF ( ISP  .LT. 5 ) GO TO 12
1392            ISP    = 0
1393            IF ( CNTRL(37)  .NE.  1 ) WRITE (LO, 609)
1394        12  ISP    = ISP+1
1395
1396
1397
1398    C       .....................................................................
1399    CC      .                                                                   .
1400    CC      .  Save data in file. There are two options. The raw data file      .
1401    CC      .  is either created/opened and closed by subroutine PACER          .
1402    CC      .  (CNTRL(39) is set to anything but to 1) or this subroutine       .
1403    CC      .  is called from subroutine ABSRV, which already has created/      .
1404    CC      .  opened and positioned the raw data file and will close it        .
1405    CC      .  (CNTRL(39) is set to 1).  In both cases the raw data are         .
1406    CC      .  written in file by this subroutine PACER.                        .
1407    CC      .                                                                   .
1408    C       .....................................................................
1409        13  WRITE (LI, 108) IFILE,NOLF
1410            JSECU = ICON(ISECU,0)
1411            JCR   = ICON(ICR,0)
1412            IBUF1(257) = IFILE(1)
1413            IBUF1(258) = IFILE(2)
1414            IBUF1(259) = IFILE(3)
1415            IBUF1(261) = JSECU
1416            IBUF1(263) = JCR
1417            IF ( CNTRL(39)  .EQ.  1 ) GO TO 16
1418            CALL CREAT (IDCB,IERR,IFILE,ISIZE,ITYPE,ISECU,ICR,IDCBS)
1419            IF ( IERR  .GT.  0 ) GO TO 15
1420            WRITE (LI, 109) IFILE
1421            READ  (LI, 149) IDUM
1422            WRITE (LI, 149) (ICLR,I=1,3,1)
1423            IF ( IDUM  .EQ.  2H$$ ) STOP 0403
1424            IF ( IDUM  .NE.  2HPU ) GO TO 14
1425            WRITE (LI, 110) IFILE,JSECU,JCR
1426            CALL PURGE (IDCB,IERR,IFILE,ISECU,ICR)
1427            IF ( IERR  .LT.  0 ) STOP 0404
1428            GO TO 13
```

```
1429       14    CALL CODE
1430             WRITE (NEW,111) IDUM
1431             WRITE (LI, 112) IFILE,NEW,IFILE(2),IFILE(3)
1432             IFILE(1) = NEW
1433             GO TO 13
1434       15    CALL OPEN  (IDCB,IERR,IFILE,IOPTN,ISECU,ICR,IDCBS)
1435             IF ( IERR  .LT.  0 ) STOP 0405
1436             IREC     = 1
1437             GO TO 17
1438       16    IF ( ICHNL  .EQ.  0 ) IREC = IREC
1439             IF ( ICHNL  .EQ.  1 ) IREC = IREC+3
1440       17    IBUF1(289) = IREC
1441             CALL WRITF (IDCB,IERR,IBUF1,IL,IREC)
1442             IF ( IERR       .LT.  0 ) STOP 0406
1443             IF ( CNTRL(39)  .EQ.  1 ) GO TO 18
1444             CALL CLOSE (IDCB,IERR,0)
1445             IF ( IERR  .LT.  0 ) STOP 0407
1446             JSECU    = ICON(ISECU,0)
1447             JCR      = ICON(ICR,0)
1448       18    WRITE (LI, 148) ICLR
1449
1450
1451
1452   C         .....................................................................
1453   C         .                                                                   .
1454   C         .  Stop data acquisition loop.                                      .
1455   C         .                                                                   .
1456   C         .....................................................................
1457       19    WRITE (LO, 610) (IBUF1(J2),J2=265,272,1),CIM,CYAW,P1,P23,P4,E,DE
1458         *   ,IOXIM,PREFR,FREQ,AVRGE,IFILE,JSECU,JCR,IREC
1459
1460
1461
1462   C         .....................................................................
1463   C         .                                                                   .
1464   C         .  Terminate subroutine;  write accounting data back                .
1465   C         .  into control array.                                              .
1466   C         .                                                                   .
1467   C         .....................................................................
1468             IF ( CNTRL(37)  .EQ.  1 ) GO TO 20
1469             CALL TIME (IMON,IDAY,IYEAR,IHOUR,IMIN)
1470             WRITE (LO, 611) IHOUR,IMIN
1471       20    CNTRL( 37) = -4
1472             CNTRL( 38) = 1
1473             CNTRL( 39) = -4
1474             CNTRL( 50) = -4
1475             CNTRL(218) = IPAGE
1476             CNTRL(219) = IDOC
1477             RETURN
1478
1479
1480
1481             END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 02561 COMMON = 00000

5. PROGRAM TXCO2

5.1. DESCRIPTION

TXCO2 is a son program of the father program TXCOØ, by which it is scheduled if one of the following operations is desired:

5 - Radial survey using the combination probe

6 - Scan through all steady state data

When scheduled by TXCOØ, which suspends operation while the son program TXCO2 executes, the program TXCO2 reads the program control array from the disc, sets the HP interface bus and the measurement and control devices to remote control and programs the digital voltmeter (DVM), the scanners and the counter. CNTRL(50) is the actual decision variable to select and call the subroutine, which performs the desired operation. When this subroutine has terminated, the interface bus and the devices are released from remote control and the control array is written into a disc file, so that the next TXCO module can read it. The correct termination of each subroutine can be verified by checking the stop codes. Note that each stop code ending in 77 indicates correct execution of a subroutine.

CNTRL(50)	Subroutine	STOP Code
5	COMB	TXCO2 : STOP 0577
6	STDY	TXCO2 : STOP 0677

Any other STOP code indicates a mistake and with the help of a program list the operator can trace the problem. The first two digits of the STOP code identify the subroutine. An example: if the program stops at STOP code 0604, the first

two digits read 6 and tells the operator that it was subroutine STDY which encountered problems. The last two digits read 04 (no error would give 77). A program list reveals that the failure occurred after attempting to purge an existing data file using FMP (File Management Package) subroutine PURGE near line 752. Maybe the cartridge, where the raw data are directed, has not been mounted with the MC-command from FMGR. STOP codes are crucial to a complex program system in order to rapidly detect and salvage problems, even during a test run.

EXTERNALS: REWRF, ABERT, RMOTE, COMB, STDY, CLEAR, LOCL

COMMON BLOCKS: FMP, CIBUF, CONTR

FORTRAN conventions for the HP 21 MX computer request COMMON blocks to be predefined in a BLOCK DATA subroutine prior to using a COMMON block in a program, subroutine or function.

BLOCK DATA Subroutine	Arrays & Variables	Length in Word
FMP	IDCB,IFILE,ISIZE,ISECIA,ICR	$227B = 151_{10}$
CIBUF	IBUF	3200B = 1664
CONTR	CNTRL	400B = 256

The arrays and variables allocated by the COMMON block FMP are frequently used for the data transfer from and to the disc. COMMON block CIBUF is designed to take the largest raw data array in the TXCO data acquisition and reduction system - IBUF(1664) in subroutine FREER. The largest data array in TXCO2 is PDAT (24, 21) with 1008 = 2*21*24 words. The TXCO2 subroutines only partially use the COMMON area. The COMMON

block CONTR allocates the space for the control array CNTRL. Since each individual subroutine saves the data prior to terminating, the buffer area for the raw data can be shared by more than one subroutine or function.

MNEMONIC ABBREVIATIONS: None

ERROR MESSAGES: If CNTRL(50) is less than 5 or greater than 6, no subroutine can be selected and the program terminates outputting an error message (FORMAT 102) to the standard input device; i.e. the terminal.

PROCEDURE: For more detailed information study the flow chart and the information given in the subroutine descriptions.

DATA FILE: None

VARIABLES IN BLOCK DATA FMP:

IDCB (144)	integer	data control block
IFILE (3)	integer	array to contain file name
ISIZE (2)	integer	array to contain # of records in the first and record length in the second 16-bit word
ISECU	integer	security code of data file
ICR	integer	cartridge reference number, where data file is located

VARIABLES IN BLOCK DATA CIBUF:

IBUF (1664)	integer	buffer array for the raw data

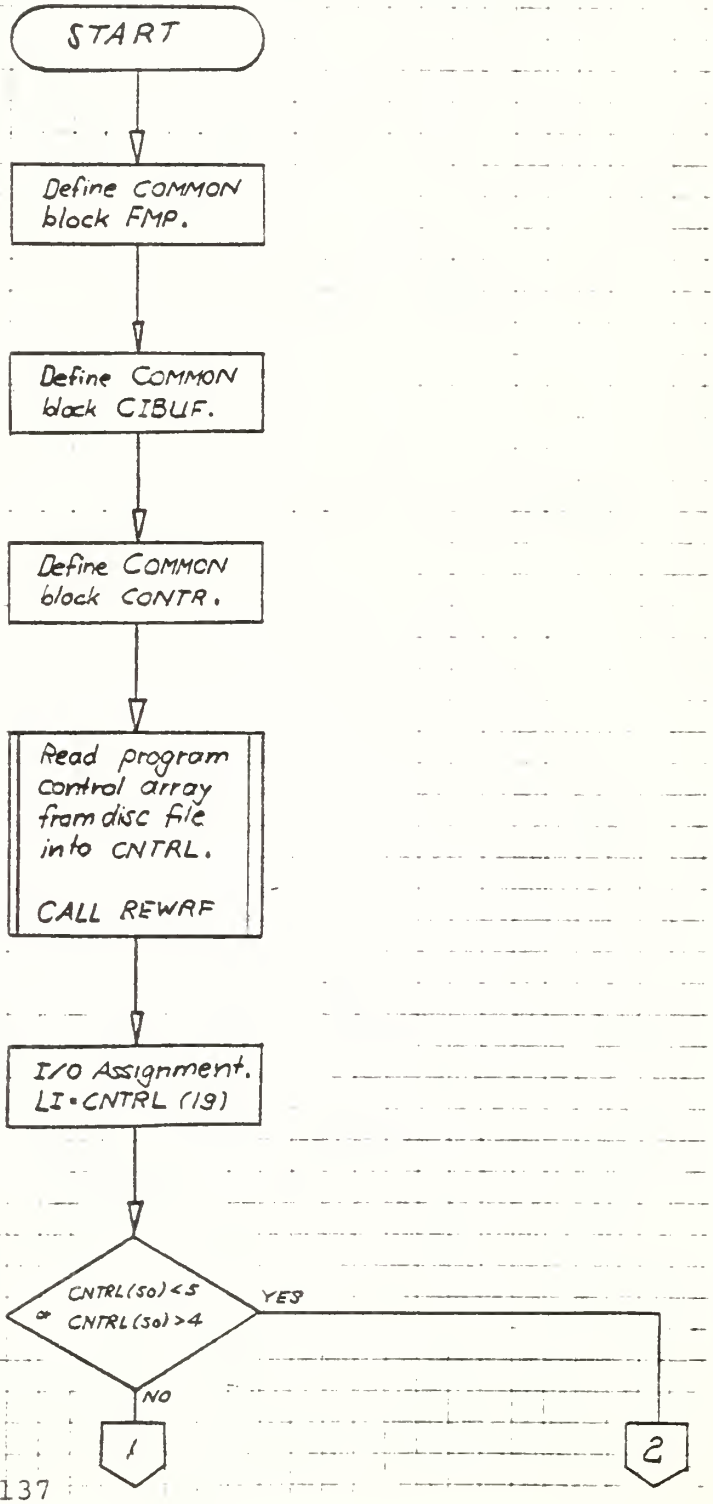
VARIABLES IN BLOCK DATA CONTR:

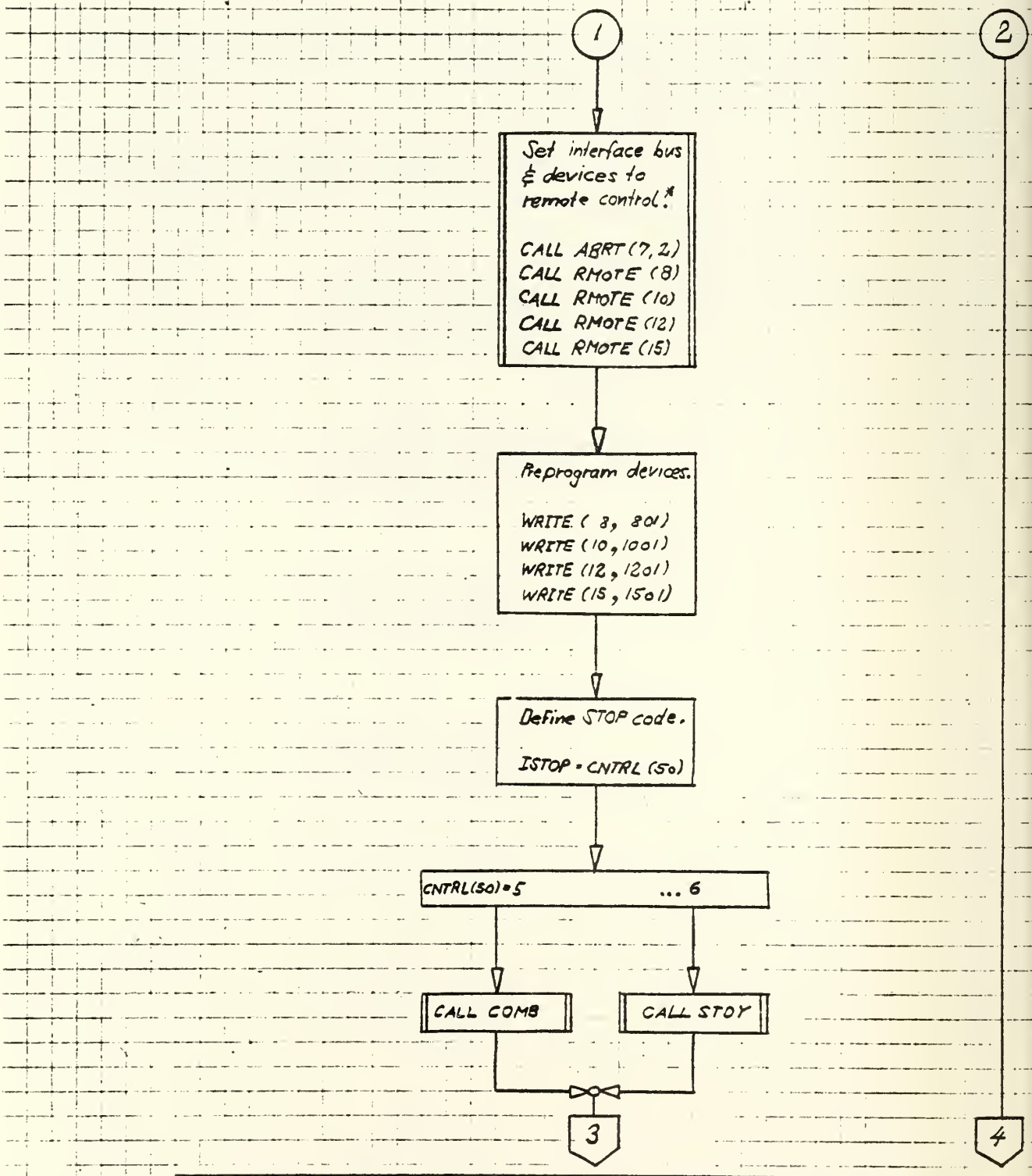
CNTRL (256)	integer	program control array

VARIABLES IN PROGRAM TXCO2:

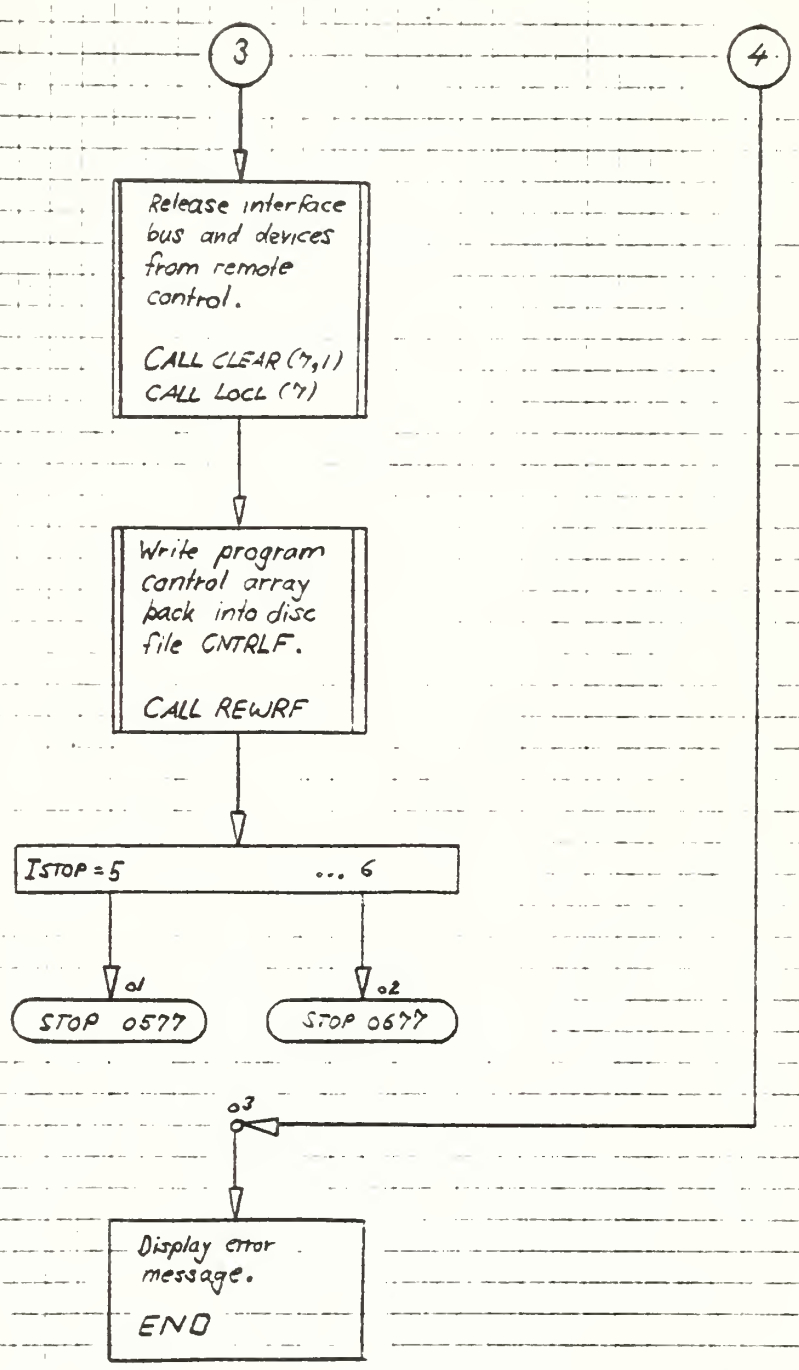
CNTRL (256)	integer	program control array
NOLF	integer	suppresses line feed
LI	integer	LU# of standard input device (terminal)
ISTOP	integer	control variable to select STOP code

FLOW CHART PROGRAM TXC02:





* LU ASSIGNMENTS: 8 Scanner #1
10 Digital Voltmeter (DVM)
12 Digital Counter
15 Scanner #2
7 HP Interface bus


3
4
Release interface bus and devices from remote control.
CALL CLEAR (7,1)
CALL LOCL (7)
Write program control array back into disc file CNTRLF.
CALL REWRF
ISTOP = 5
... 6
01
02
STOP 0577
STOP 0677
03
Display error message.
END

5.2. SUBROUTINE COMB:

PURPOSE: Acquisition of flow data from the transonic 1-stage axial compressor using a pneumatic 4-hole combination probe. The data necessary for the reduction procedure (PROGRAM REDCO: Reduce Combination probe data) are recorded also. Up to 24 different radial positions can be recorded. Taking more than one scan at one and the same radial position should be avoided, because the reduction program (originally written by R. Shreeve for the Laboratory's HP 9830 calculator and rewritten by F. Neuhoff for the more advanced HP 21 MX computer) is not set up for this condition.

ARGUMENTS: None

EXTERNALS: TIME, SCANR, ACQN, CREAT, PURGE, OPEN, WRITF, CLOSE

COMMON BLOCKS: CIBUF, CONTR, FMP. For detailed explanation refer to the TXCO2 description.

MNEMONIC ABBREVIATIONS:

RE ... Repeat data acquisition at this radial position.

NE ... Proceed to the next radial position.

EN ... End survey at this operating condition.

UP ... Update position readings of probes prior to data taking.

TA ... Initialisation command to take data.

TR ... Transfer raw data to HP 9830.

ST ... Store raw data in 21 MX disc file.

PU ... Allow purge of an existing data file.

ERROR MESSAGES: None

PROCEDURE: For more detailed information, study the flow chart. After having assigned the accounting data, assigned the I/O references, COMB asks the operator whether the radial survey takes place ahead of the (IPOS = 1) rotor or behind the (IPOS = 2) rotor. IPOS later will be used to identify the correct data port (see Appendix A.1: Data Locations). The raw data array IBUF - which is set equivalent to real array PDAT (Prob Data; used instead of IBUF, which is an integer array) is first preset with zeroes. Before the operator goes ahead and allows the subroutine to gather data (Input: TA; see key to raw data array), he can monitor the probe positions by updating its reading (Input: UP), until the probe is manually set to the desired position. Upon completion of the data scan the acquired data are printed and the next step depends on the operator's decision. If a preliminary check reveals erroneous data, the scan at this radial position should be repeated (Input: RE). If the data are correct, the operator either proceeds to the next radial position (Input: NE) or terminates the radial combination probe survey (Input: EN) at this operating condition. The subroutine then asks where to dump the data. When this routine was developed the data reduction program for the combination probe was not available in the 21 MX system, hence the option to transfer the data to the 9830 calculator (Input: TR) was used. But the data can as well be stored in a 21 MX disc file (Input: ST). If the raw data file with the automatically

determined name already exists, the operator either allows overwriting the existing file (Input: PU) or renames the current data file (Input: any alphabetic character other than T). The subroutine terminates printing the data file name at the bottom of the data documentation page.

DATA FILE: The default file name is T5rrss (rr ... ASCII converted run #; ss ... ASCII converted sequential #).

VARIABLES:

IBUF (1664)	integer	buffer array
CNTRL (256)	integer	control array
IDCB (144)	integer	data control block, used for FMP calls
IFILE (3)	integer	array to contain current file name
ISIZE (2)	integer	specifies # of records and record length
ISECU	integer	security code of data file
ICR	integer	cartridge reference number, where the raw data file is located
JSECU	integer	ASCII converted security code
JCR	integer	ASCII converted cartridge reference number
PDAT(21,24)	real	raw data array, set equivalent to IBUF

POS (7)	real	array to contain probe positions
NOLF	integer	suppresses line feed
NOCR (2)	integer	suppresses line feed and carriage RETURN
ICLR (3)	integer	clears line above cursor
IDCBS	integer	length of data control block
IENTR	integer	multiple entry flag
IDOC	integer	count of current program run
IDOCF	integer	count of current data file sequential #
ITYPE	integer	type of raw data file
IL	integer	number of words to be transferred in FMP calls
LI	integer	LU# of standard input device (terminal)
LO	integer	LU# of standard output device (line printer)
IPOS	integer	Flag to indicate measurement location
IMON	integer	ASCII converted month of current year
IYEAR	integer	ASCII converted last two digits of current year
IDAY	integer	ASCII converted day of the month
IHOUR	integer	ASCII converted hour of the day (24 h clock)
IMIN	integer	ASCII converted minute of the hour

JI	integer	Subscript for data array PDAT
IS	integer	LU# of the selected scanner
IC	integer	Instrument code (DVM ... 1 and digital counter ... 3)
I2	integer	Subscript for position array POS
J3	integer	Contains channel of desired scanner
IDUM	integer	Decision variable
IW	integer	Determines delay in tens of milliseconds between closing S/V port and DVM reading
JO	integer	Number of selected S/V
SUM	real	Variable used to compute average
ISYNCH	integer	Synchronisation variable to coordinate data transfer 21 MX ⟶ 9830
NEW	integer	Scratch variable used to rename files

Key to data array PDAT

PDAT (1,J1) Barometric pressure p_{BARO}

PDAT (2,J1) KULITE reference pressure

PDAT (3,J1) Combination probe pressure p_1

PDAT (4,J1) Combination probe pressure p_{23}

PDAT (5,J1) Combination probe pressure p_4

PDAT (6,J1) Total pressure ahead of compressor p_t

PDAT (7,J1) Static port in casing #2 , S_2

PDAT (8,J1) Static port in casing #13 , S_{13}

PDAT (9,J1) Average reading of 4 static ports in Hub (#2 thru 5) $(H_1 + H_2 + H_3 + H_4)/4$

PDAT (10,J1) Pressure ahead of compressor flow meter orifice $P_{1\ \text{nozzle compr}}$

PDAT (11,J1) Temperature ahead of compressor flow meter orifice $T_{1\ \text{nozzle compr}}$

PDAT (12,J1) Pressure drop across compressor flow meter orifice $p_{\text{nozzle compr}}$

PDAT (13,J1) Temperature reading from reference probe T_{ref}

PDAT (14,J1) Differential temperature reading from the combination probe to the reference probe T_{probe}

PDAT (15,J1) Radial immersion of the combination probe

PDAT (16,J1) Yaw angle of the combination probe

PDAT (17,J1) Case angle

PDAT (18,J1) Compressor RPM

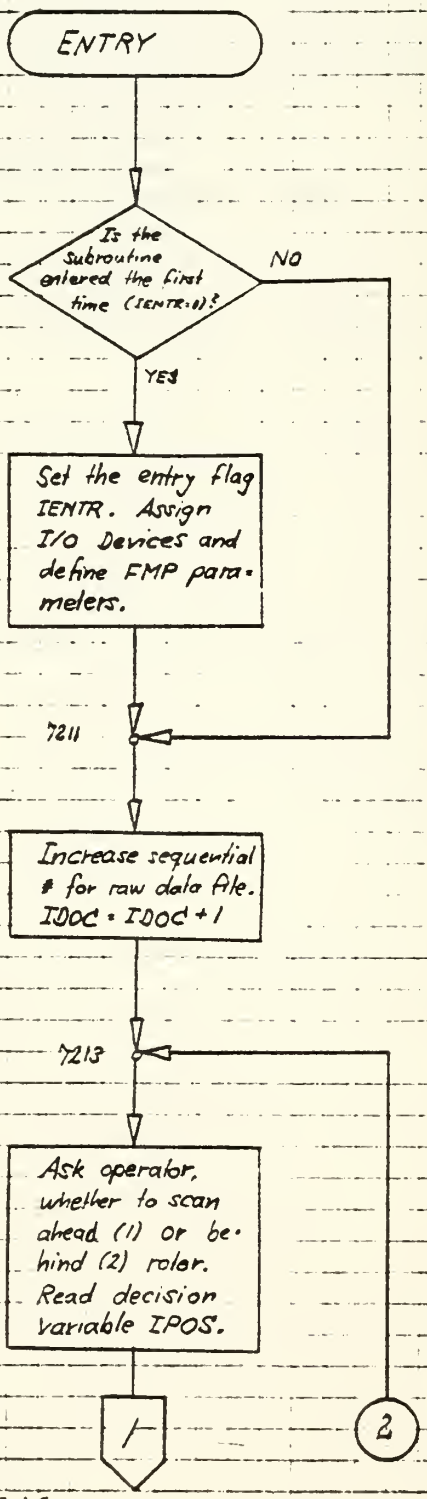
PDAT (19,J1) Test run #

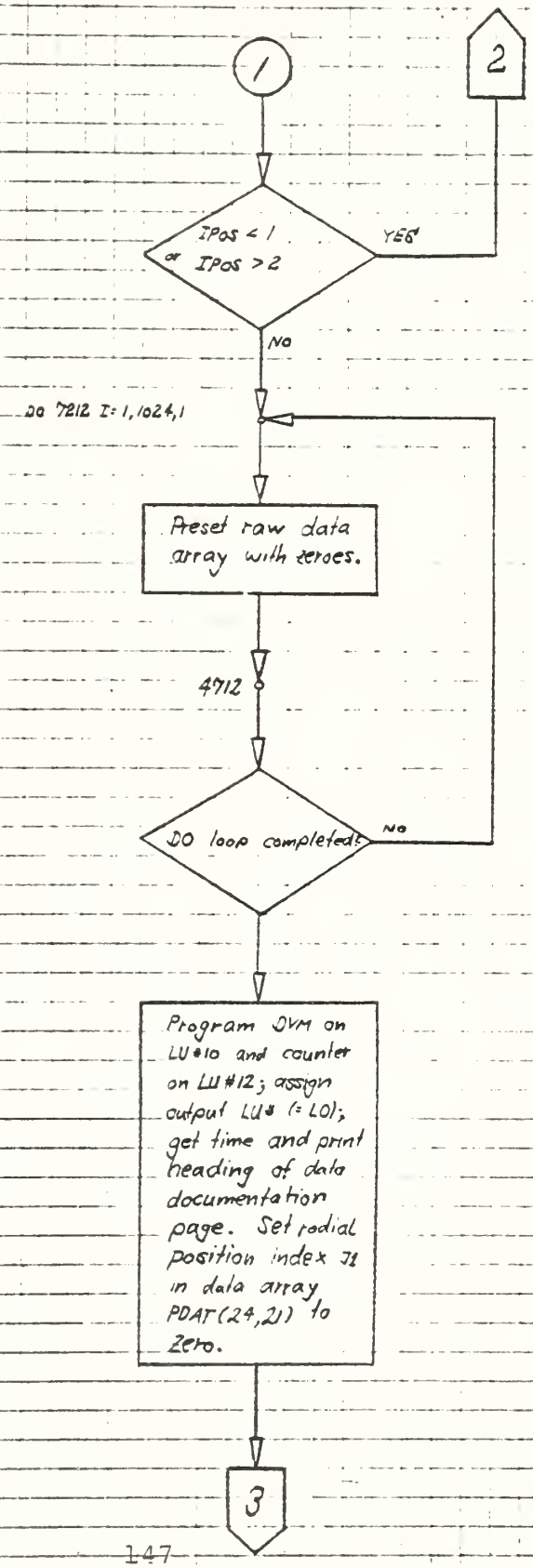
PDAT (20,J1) Test # of this run

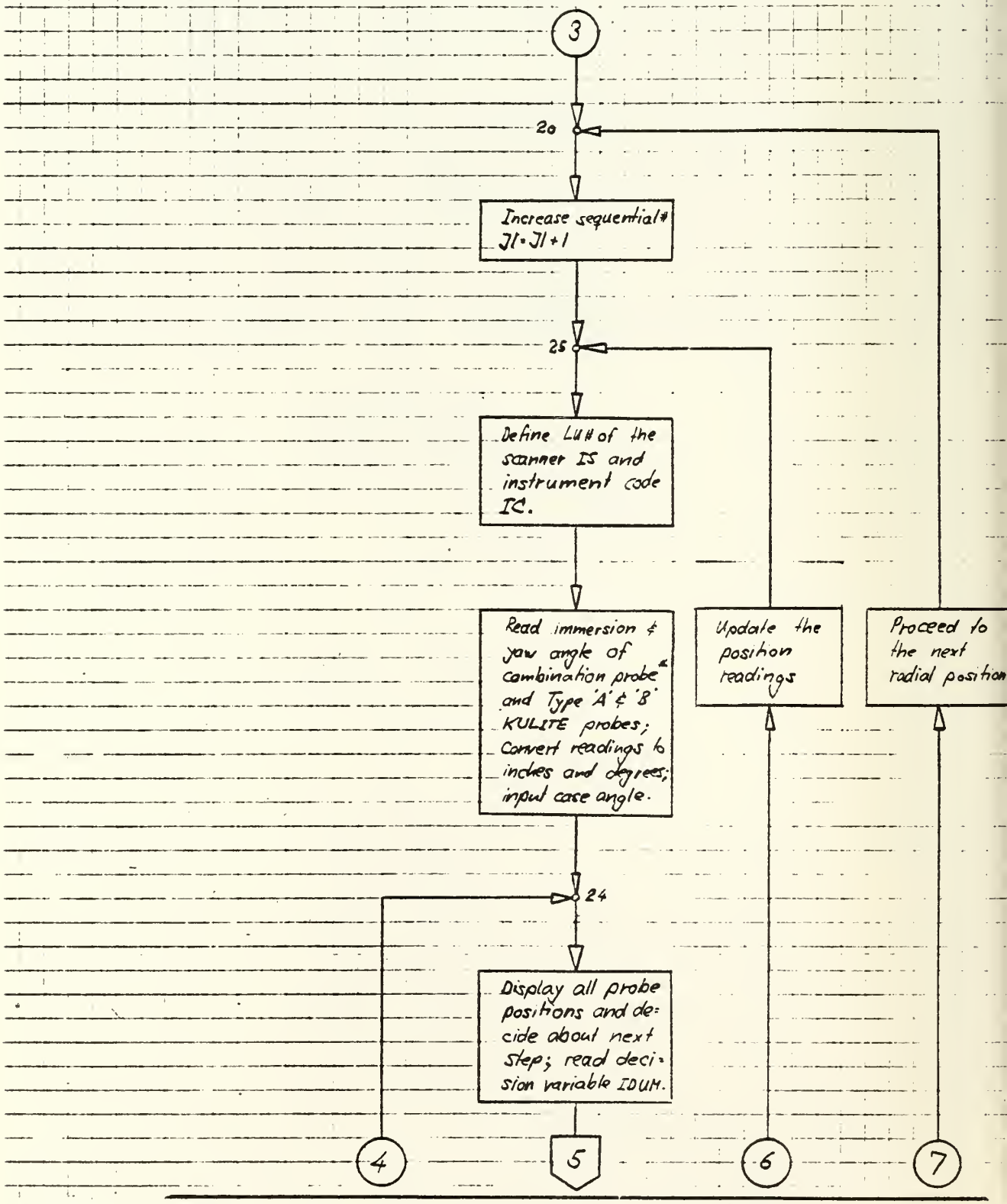
PDAT (21,J1) Point # of this test

J1 = 1 ... 24 indicates # of radial position.

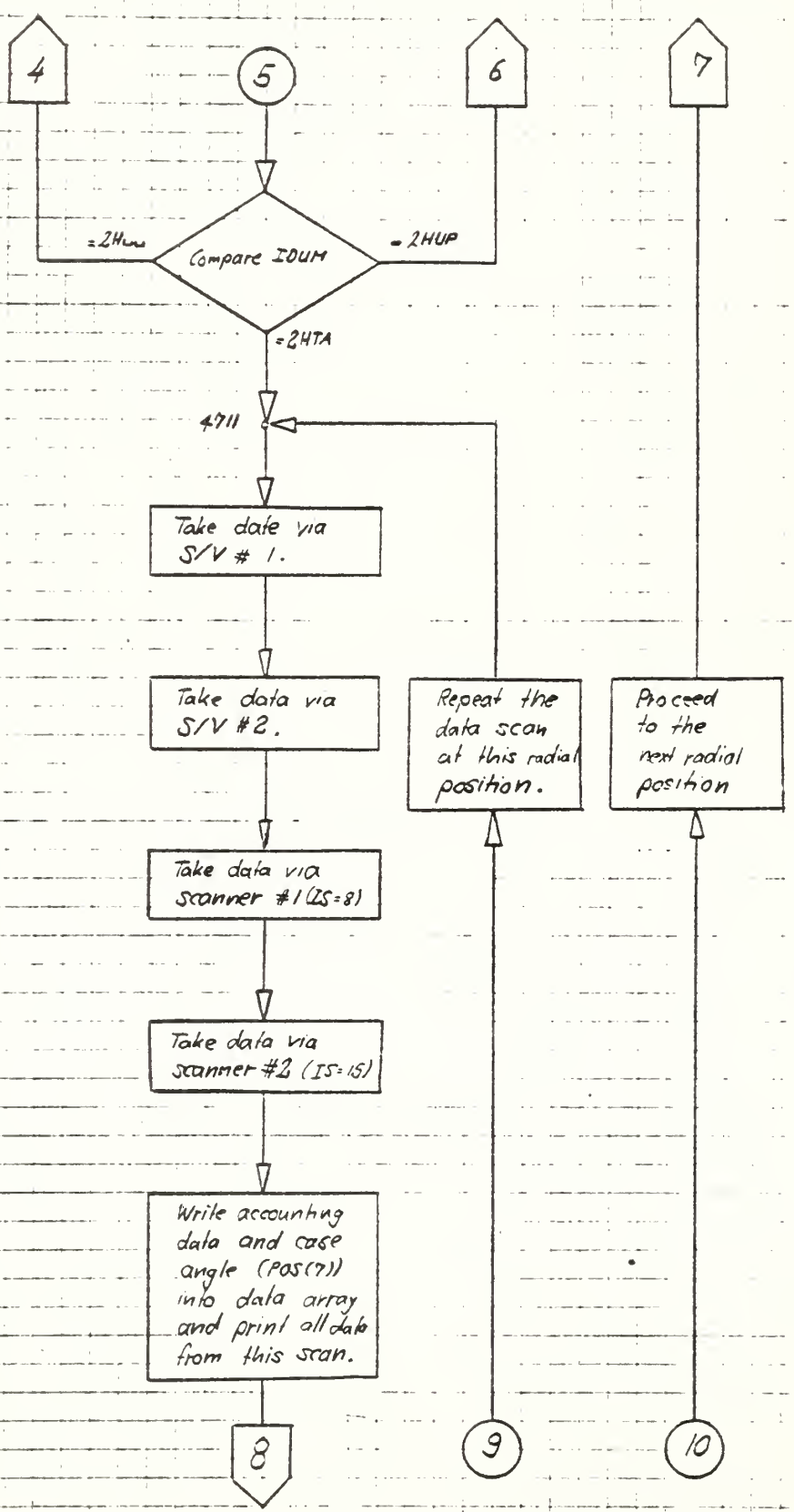
FLOW CHART SUBROUTINE COMB

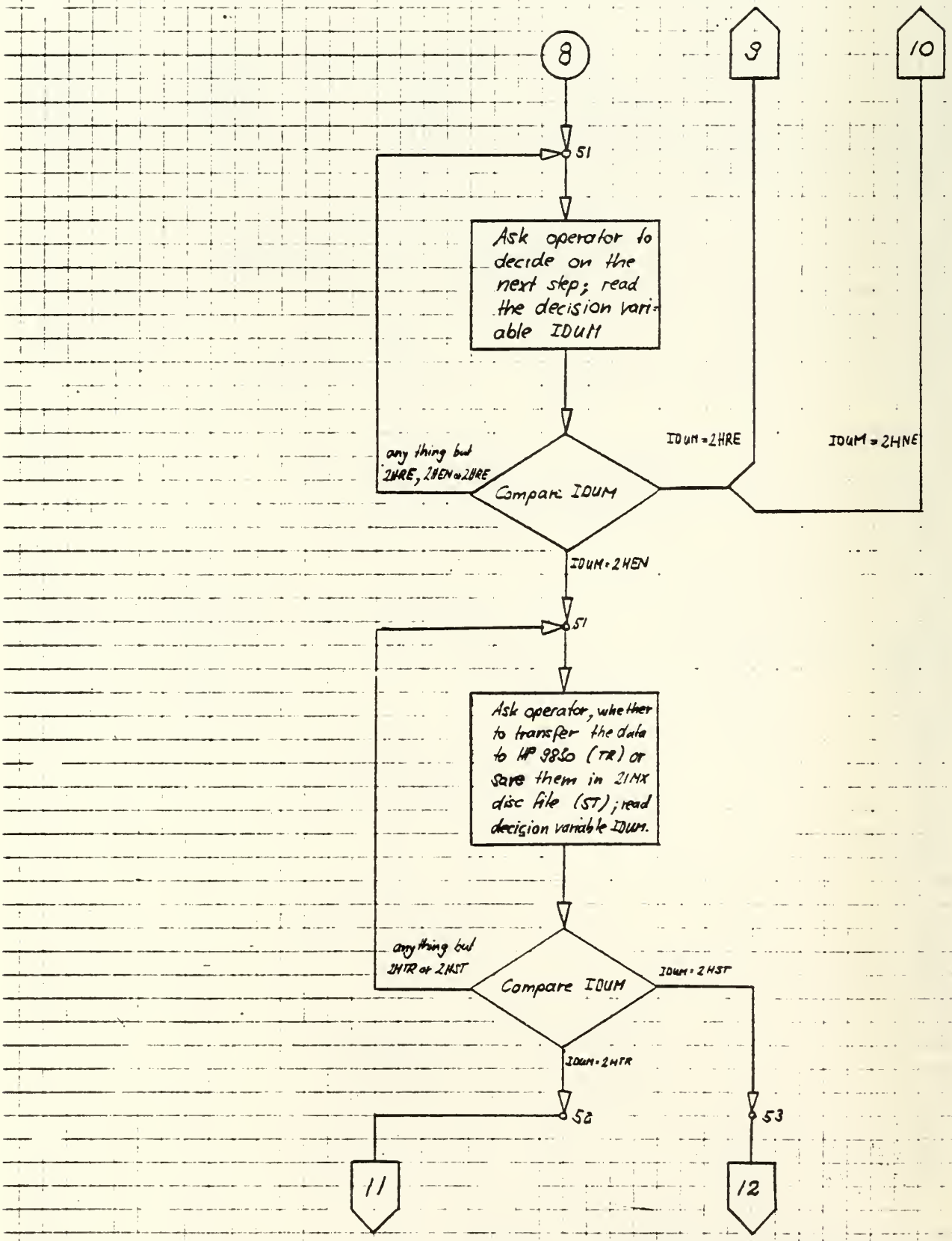

ENTRY
Is the Subroutine entered the first time (IENTR=1)?
NO
YES
Set the entry flag IENTR. Assign I/O Devices and define EMP parameters.
7211
Increase sequential # for raw data file. IDOC = IDOC + 1
7213
Ask operator, whether to scan ahead (1) or behind (2) roler. Read decision variable IPOS.
1
2

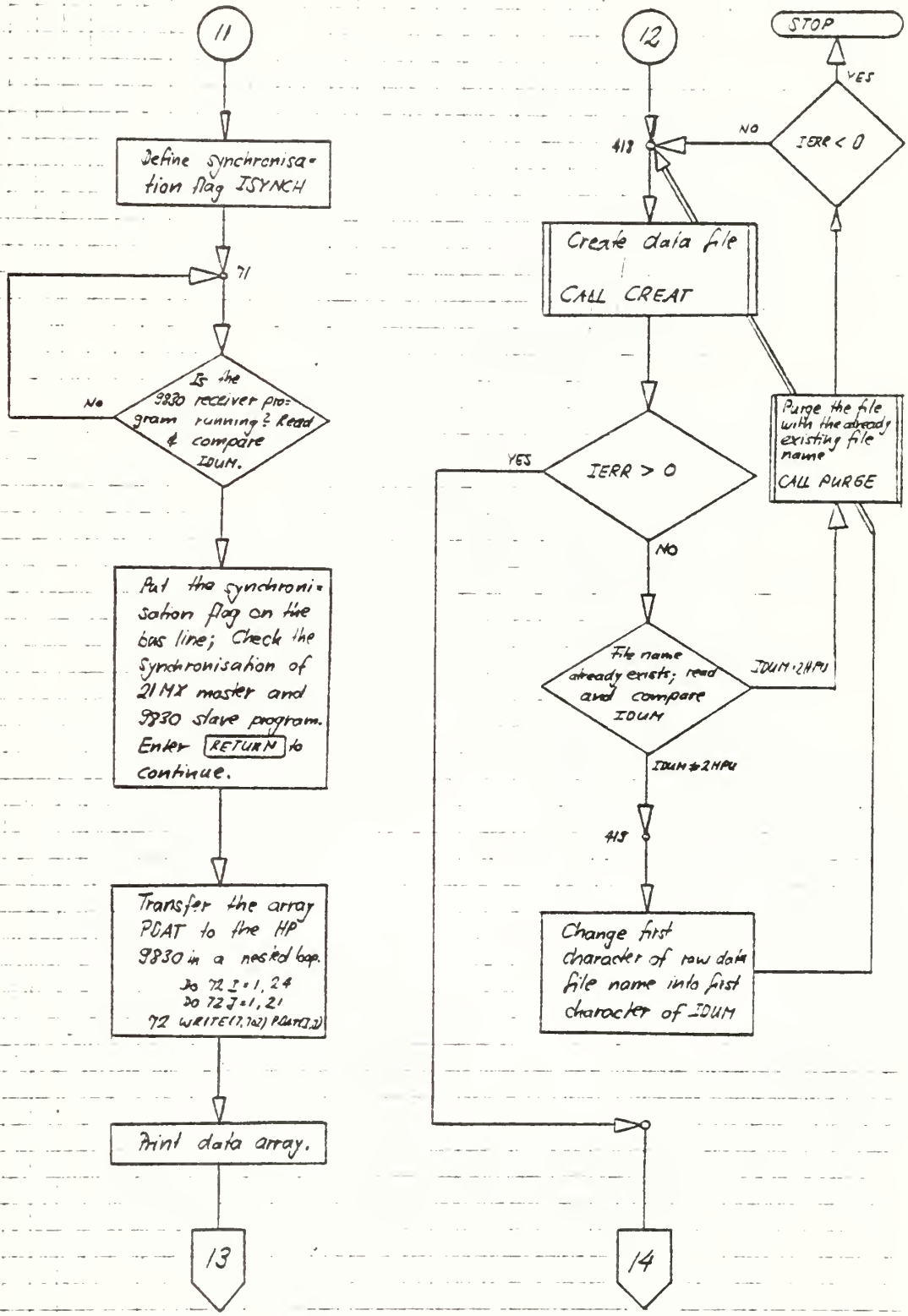

1
2
IPOS < 1
or IPOS > 2
YES
NO
DO 7212 I=1,1024,1
Preset raw data array with zeroes.
4712
DO loop completed?
NO
Program DVM on LU#10 and counter on LU#12; assign output LU# (=LO); get time and print heading of data documentation page. Set radial position index J1 in data array PDAT(24,21) to zero.
3

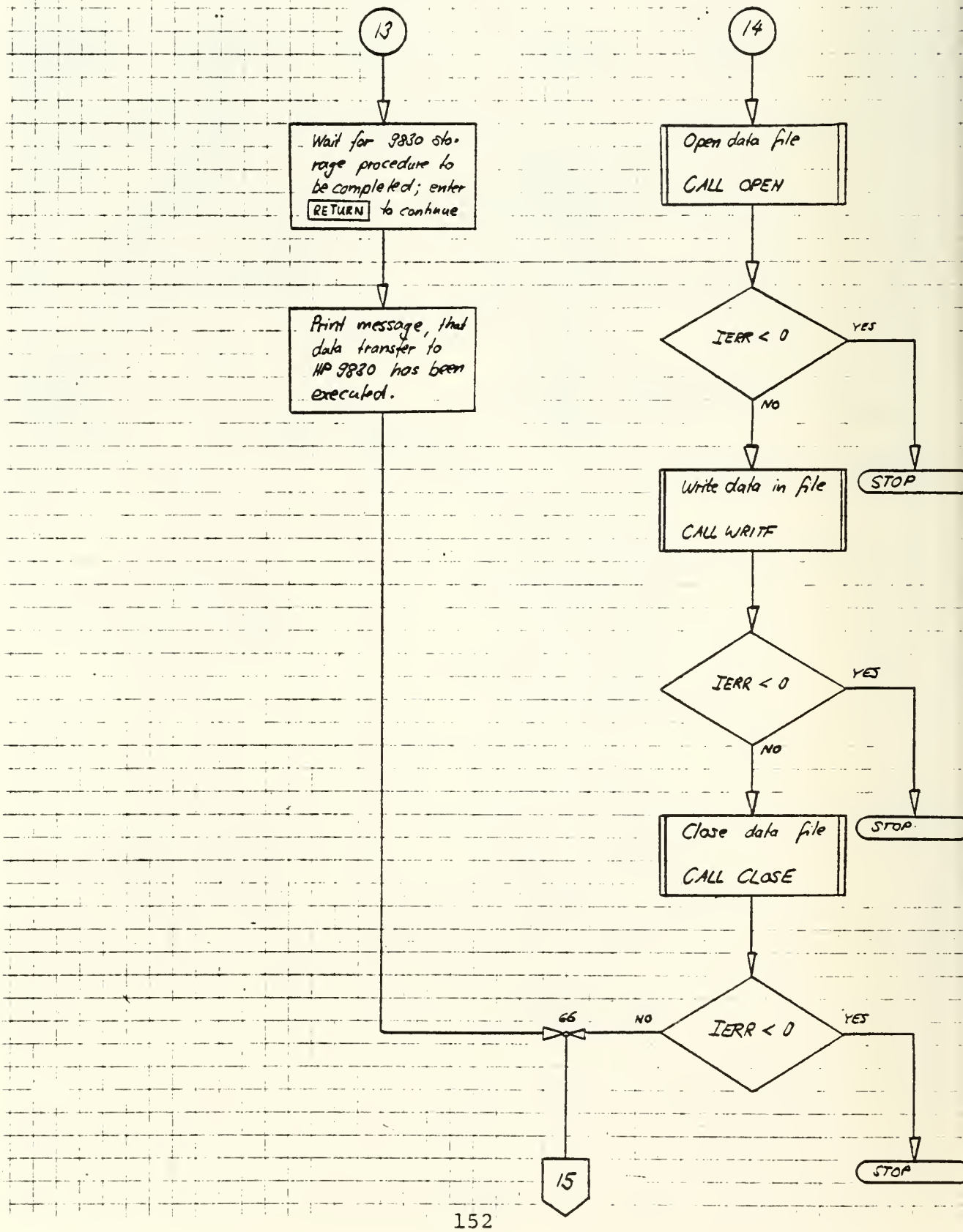

3
20
Increase sequential# JI=JI+1
25
Define LU# of the scanner IS and instrument code IC.
Read immersion & yaw angle of combination probe* and Type 'A' & 'B' KULITE probes; Convert readings to inches and degrees; input case angle.
Update the position readings
Proceed to the next radial position
24
Display all probe positions and decide about next step; read decision variable IDUM.
4
5
6
7

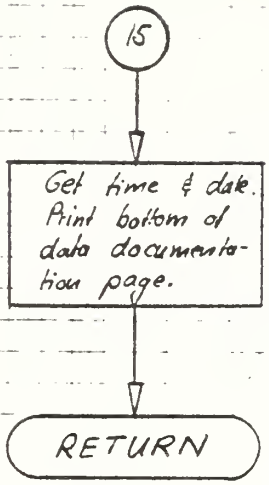
*) Refer to Appendix A1 : work sheet data locations. The location of immersion and yaw angle for the combination probe depends on where to take 'em (ire


4
5
6
7
Compare IOUM
=2HUP
=2HTA
4711
Take data via S/V # 1.
Take data via S/V #2.
Take data via scanner #1 (IS=8)
Take data via scanner #2 (IS=15)
Write accounting data and case angle (POS(7)) into data array and print all data from this scan.
Repeat the data scan at this radial position.
Proceed to the next radial position
8
9
10


8
9
10
S1
Ask operator to decide on the next step; read the decision variable IDUM
any thing but 2HRE, 2HEN or 2HNE
Compare IDUM
IDUM = 2HRE
IDUM = 2HNE
IDUM = 2HEN
S1
Ask operator, whether to transfer the data to HP 9880 (TR) or save them in 21MX disc file (ST); read decision variable IDUM.
anything but 2HTR or 2HST
Compare IDUM
IDUM = 2HST
IDUM = 2HTR
S2
S3
11
12


11
Define synchronisation flag ISYNCH
71
Is the 9830 receiver program running? Read & compare IDUM.
No
Put the synchronisation flag on the bus line; Check the synchronisation of 21MX master and 9830 slave program. Enter RETURN to continue.
Transfer the array PDAT to the HP 9830 in a nested loop.
DO 72 I=1,24
DO 72 J=1,21
72 WRITE(7,702) PDAT(I,J)
Print data array.
13
12
STOP
YES
NO
IERR < 0
413
Create data file
CALL CREAT
Purge the file with the already existing file name
CALL PURGE
YES
IERR > 0
NO
File name already exists; read and compare IDUM
IDUM=2HPU
IDUM≠2HPU
413
Change first character of raw data file name into first character of IDUM
14


13
14
Wait for 9830 storage procedure to be completed; enter RETURN to continue
Open data file
CALL OPEN
Print message, that data transfer to HP 9830 has been executed.
IERR < 0
YES
NO
STOP
Write data in file
CALL WRITF
IERR < 0
YES
NO
STOP
Close data file
CALL CLOSE
66
NO
IERR < 0
YES
STOP
15


15
Get time & date. Print bottom of data documentation page.
RETURN

5.3. SUBROUTINE STDY:

PURPOSE: Acquisition of flow data from the transonic 1-stage axial compressor using the steady state instrumentation. All data, gathered by this subroutine, will be used for the reduction (PROGRAM REDST: Reduce Steady state data; see section 8.3 of this report). The data array is designed to both resemble the data source location matrix (see Appendix A.1) and to discriminate groups of similar data by blank lines (Appendix A.2). CH3(1) through CH3(5), which contain all the pressures needed to calculate the flow rates, and CH3(6), which is left blank, separates this group of data from the next one. The reason is to allow the investigator a quick check and verification of crucial data. The "units" of the readings depend on the amplifier settings, but usually each channel is calibrated to allow the operator to read voltages as a quantity in engineering units. As far as possible, amplifier drift is traced by the program (CH1(1), CH2(1) etc.). (The author is indebted to Laboratory's manager, Mr. Jim Hammer, who, with admirable patience, instructed the author in how best to handle data and data systems.)

ARGUMENTS: IRUN; if IRUN is set to 0 (zero), taking pressure readings from the Scanivalves (S/V) is skipped. This option was needed when the subroutine was first written so that frequent debugging runs did not put additional loads on the S/V's. The standard entry is: IRUN = 1. Only then will the reduction program REDST perform correctly.

EXTERNALS: TIME, ACQN, SCANR, CREAT, PURGE, OPEN, WRITF, CLOSE

COMMON BLOCKS: CIBUF, CONTR, FMP. For detailed explanation refer to the TXCO2 description

MNEMONIC ABBREVIATIONS:

RP ... Repeat data acquisition at this operating condition

RT ... End data acquisition and return to calling program

PU ... Allow purge of an existing data file

ERROR MESSAGES: None

PROCEDURE: For more detailed information, study the flow chart. After having assigned the accounting data and defined the I/O references, STDY presets all elements of the raw data array with -0.999999, which definitely never will occur as a data reading. Next, unless IRUN equals 0 (zero), the pressures on Scanivalves 1 and 4 are read. The voltages from scanner #1 (LU# = 8) and scanner #2 (LU# 15) are read next, not depending on the value of IRUN. Note, that the allocation for the voltages in the raw data array provides blocks of similar data, separated by blank lines. A set of control parameters (CNTRL (1) thru CNTRL (6); and CNTRL (15) and the case angle - which needs to be put in manually - completes the steady state data. Then the raw data is printed to allow the operator to look at and to verify the newly acquired data. The data scan can either be repeated (Input: RP) or the subroutine terminates (Input: ST) storing the data in a type 1 disc file. If the automatically determined name for the data file already exists,

the operator either allows overwriting the existing file (Input: PU) or renames the current data file (Input: any alphabetic character other than T). Finally data file name and time are printed at the bottom of the data documentation page.

DATA FILE: The default file name is T4rrss (rr ... ASCII converted run #; ss ... ASCII converted sequential #); see Appendix A.2: Steady State Data Array. CH4 (1) through CH4 (26) are not used, because the reduction program will write its results into these slots.

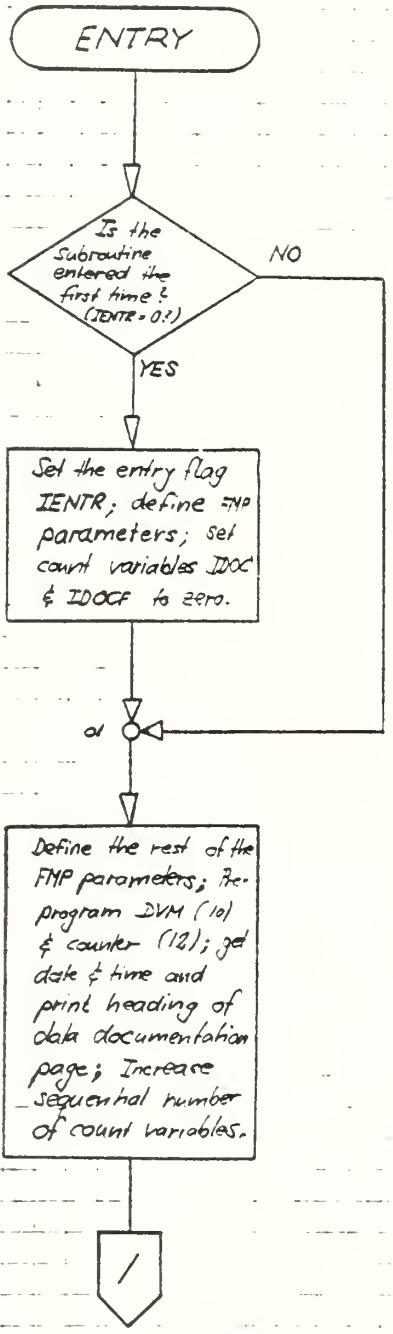
VARIABLES:

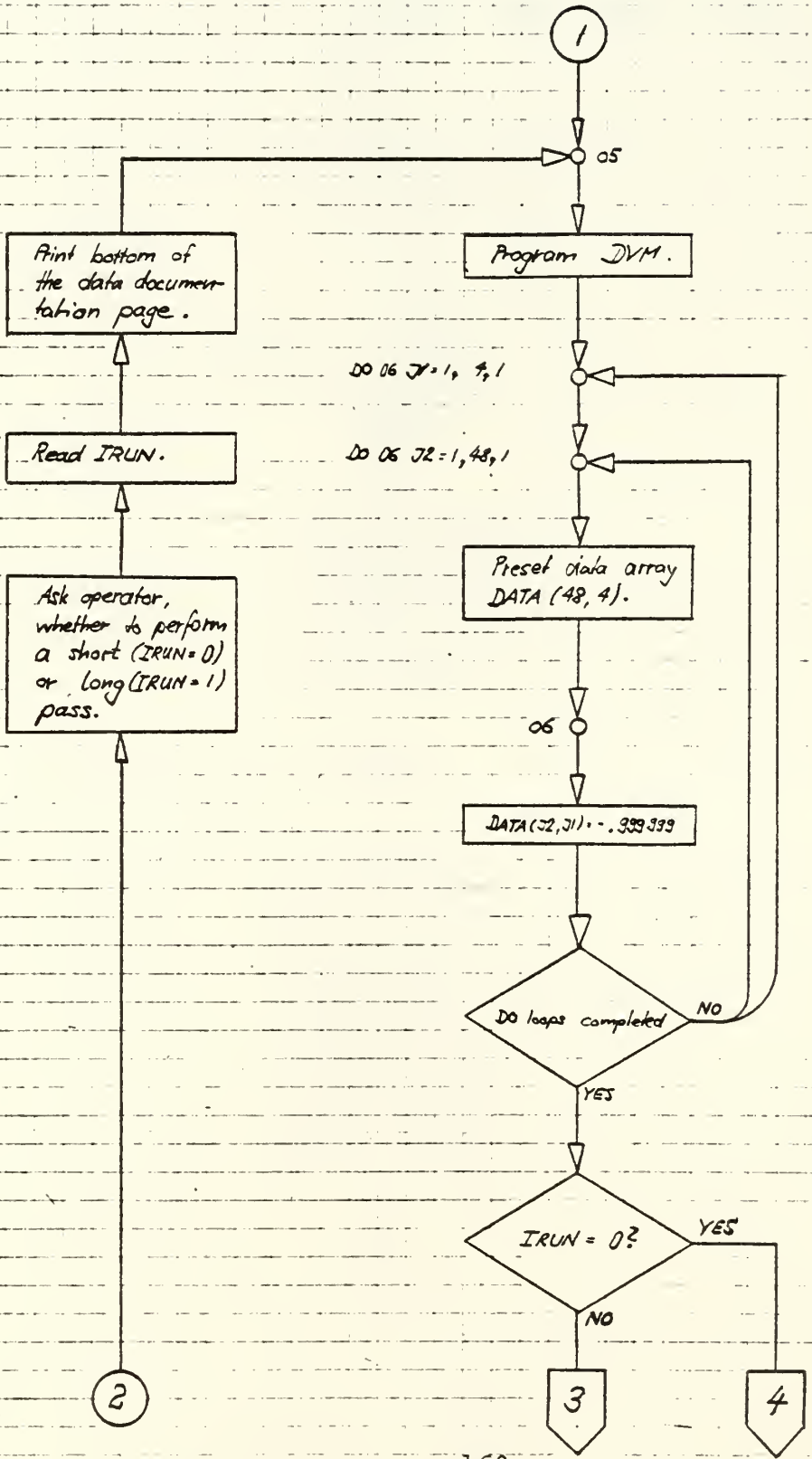
IBUF (1664)	integer	buffer array
CNTRL (256)	integer	control array
IDCB (144)	integer	data control block, used for FMP calls
IFILE (3)	integer	array to contain current file name
ISIZE (2)	integer	specifies # of records and record length
ISECU	integer	security code of data file
ICR	integer	cartridge reference number, where the raw data file is located
JSECU	integer	ASCII converted security code
JCR	integer	ASCII converted cartridge reference number
DATA (48,4)	real	raw data array, set equivalent to IBUF

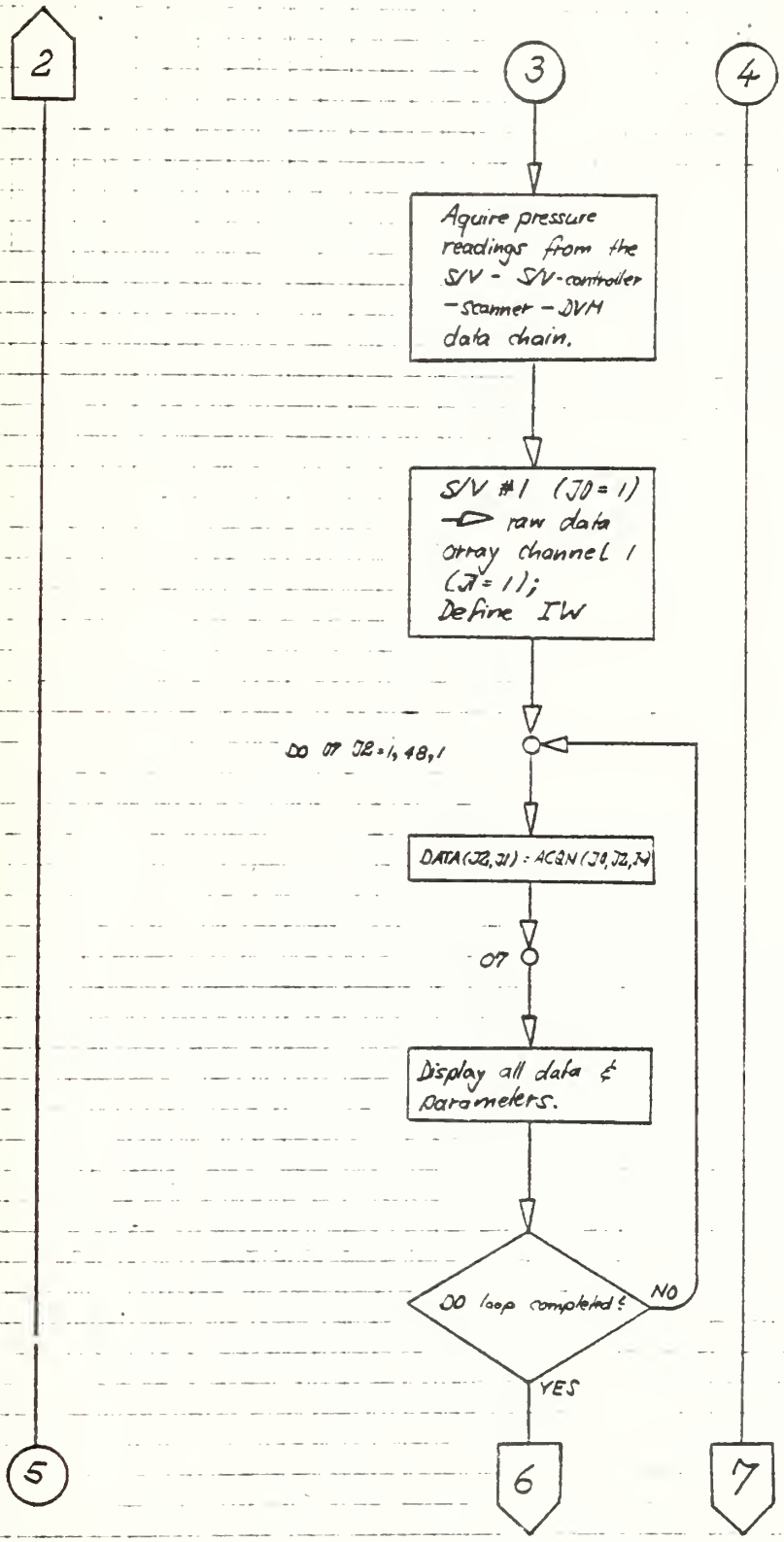
NOLF	integer	suppresses line feed
NOCR (2)	integer	suppresses line feed and carriage RETURN
ICLR (3)	integer	clears line above cursor
IENTR	integer	multiple entry flag
IDOC	integer	count of current program run
IDOCF	integer	count of current data file sequential #
ITYPE	integer	type of raw data file
IL	integer	number of words to be transferred in FMP calls
IFRST	integer	temporary buffer variable
LI	integer	LU # of standard input device (terminal)
LO	integer	LU # of standard output device (line printer)
J1	integer	subscript for data array DATA, specifies channel
J2	integer	subscript for data array DATA
IRUN	integer	control variable
JO	integer	number of selected S/V
IW	integer	determines delay in tens of milliseconds between closing S/V port and DVM reading
TARE1	real	drift of amplifier S/V#1 during test run

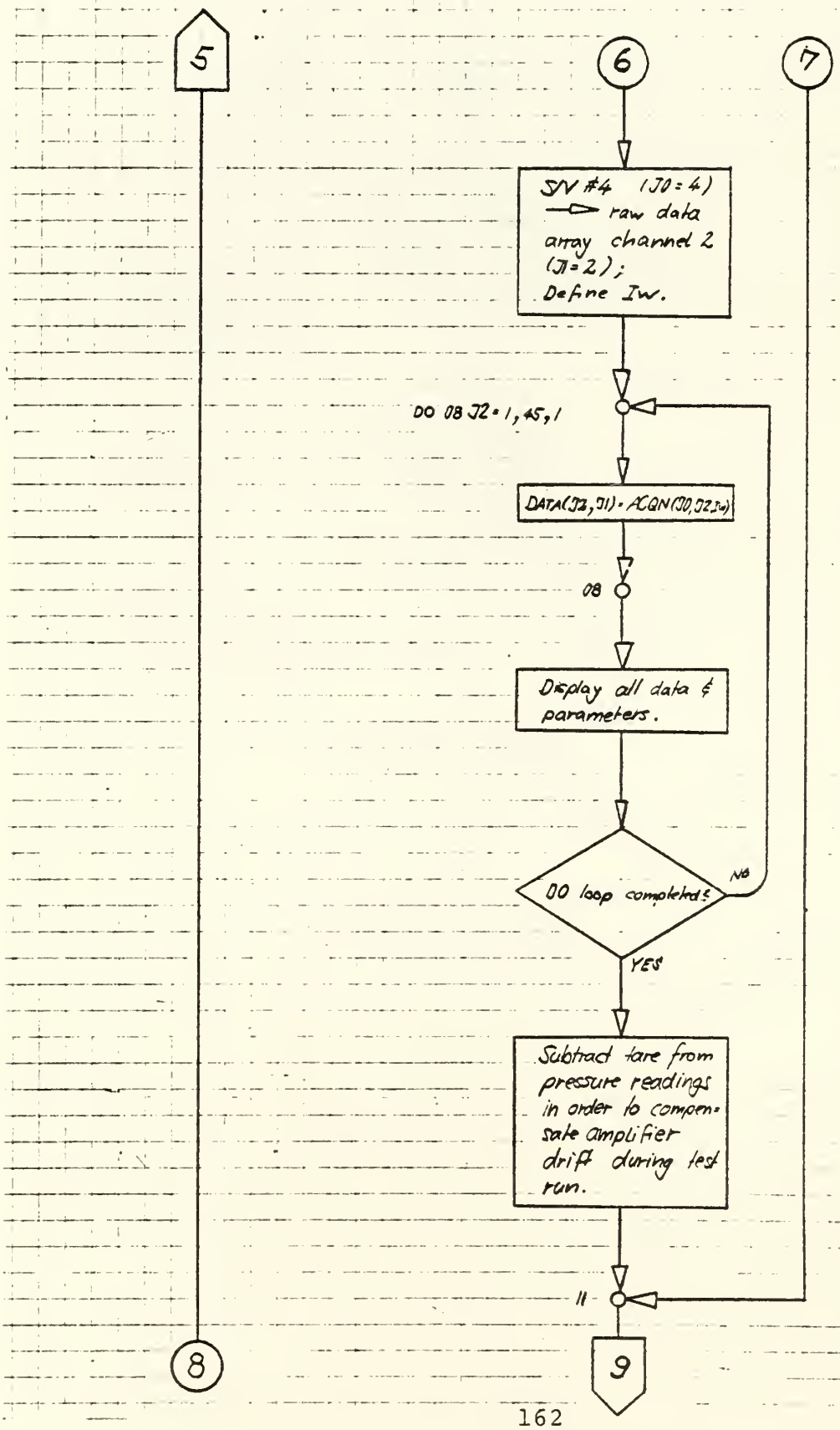
TARE2	real	drift of amplifier S/V #4 during test run
IS	integer	LU # of the selected scanner
IC	integer	instrument code (DVM ... 1 and digital counter ... 2)
J3	integer	contains channel of scanner
NO(2)	integer	ASCII text to be printed, if value of DATA (J2,J1) = -.999899
IDUM	integer	decision variable
IMON	integer	ASCII converted month of current year
IDAY	integer	ASCII converted day of the month
IYEAR	integer	ASCII converted last two digits of current year
IHOUR	integer	ASCII converted hour of the day (24 h clock)
IMIN	integer	ASCII converted minute of the hour
NEW	integer	scratch variable used to rename files

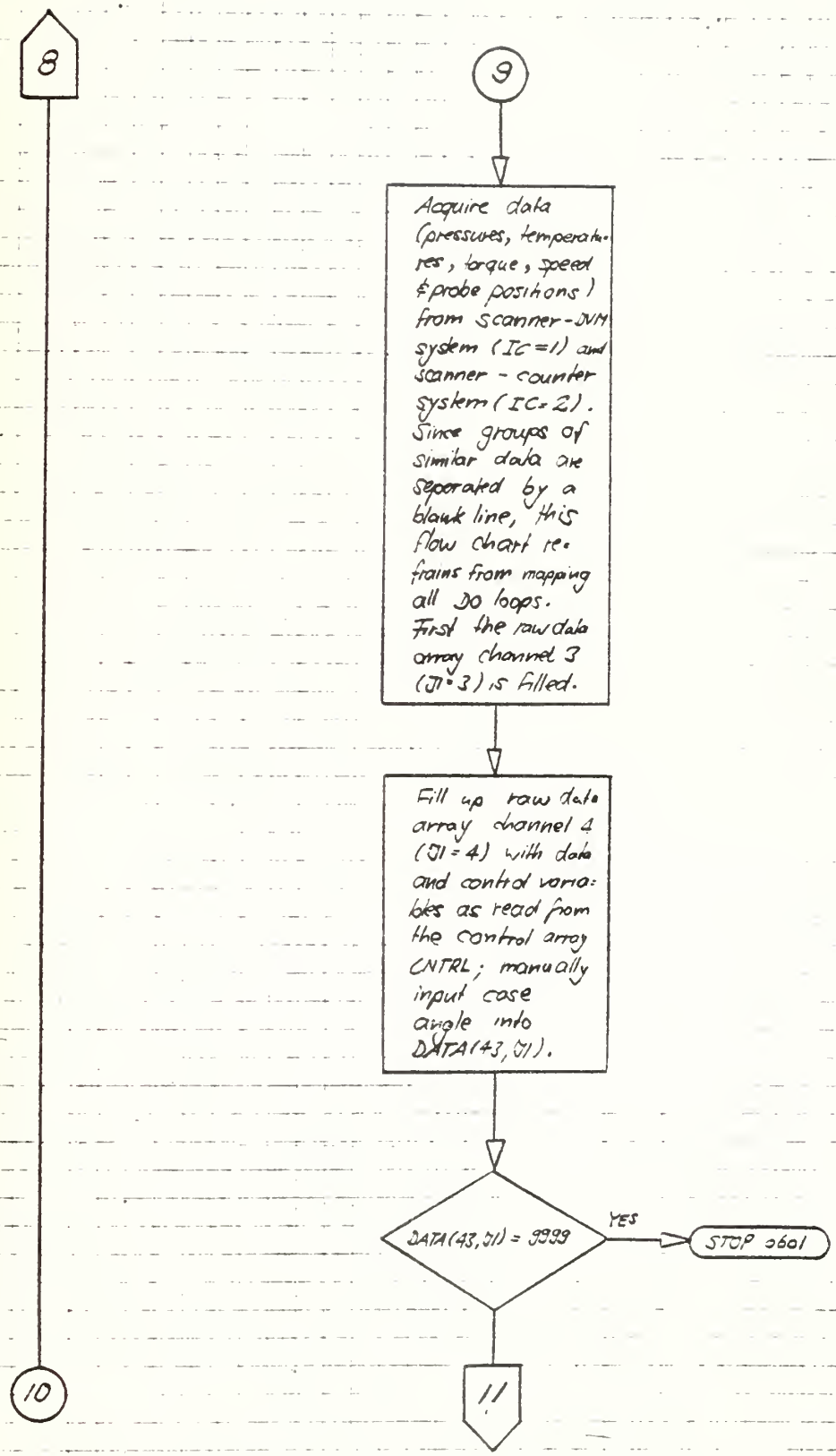
FLOW CHART SUBROUTINE STDY

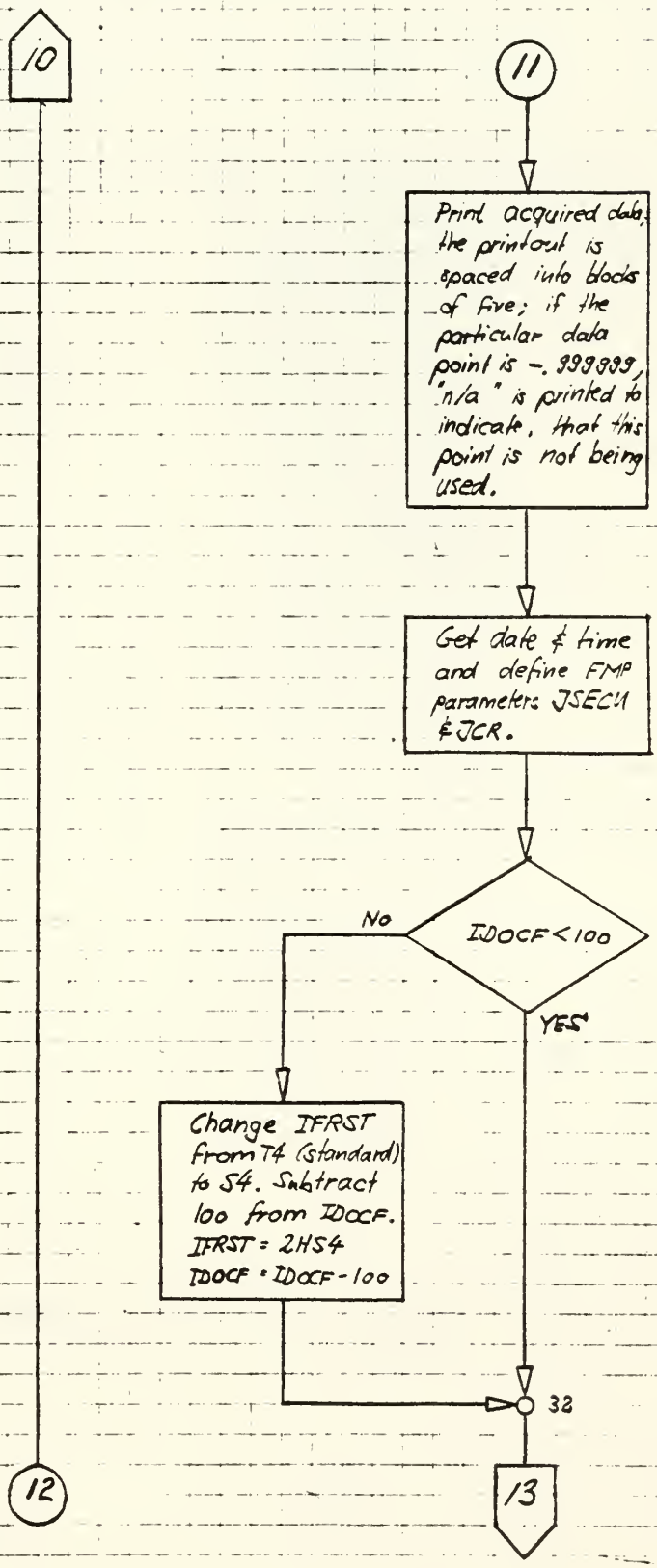

ENTRY
Is the Subroutine entered the first time? (IENTR = 0?)
NO
YES
Set the entry flag IENTR; define FMP parameters; set count variables IDOC & IDOCF to zero.
a
Define the rest of the FMP parameters; Re-program DVM (10) & counter (12); get date & time and print heading of data documentation page; Increase sequential number of count variables.
1

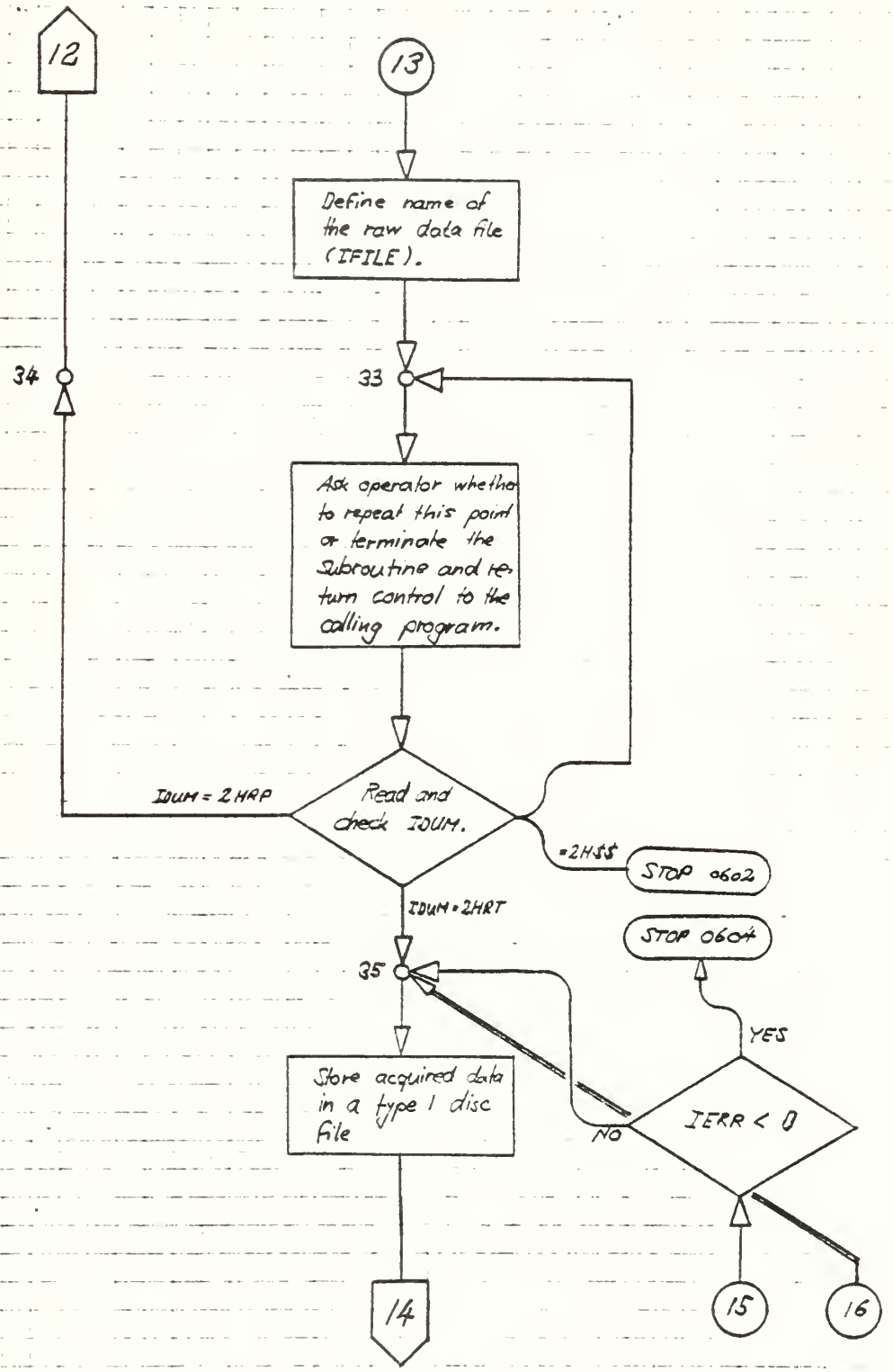

1
05
Program DVM.
DO 06 J1=1, 4, 1
DO 06 J2=1,48,1
Preset data array DATA (48, 4).
06
DATA(J2,J1)=-.999999
DO loops completed
NO
YES
IRUN = 0?
YES
NO
3
4
Print bottom of the data documentation page.
Read IRUN.
Ask operator, whether to perform a short (IRUN=0) or long (IRUN=1) pass.
2

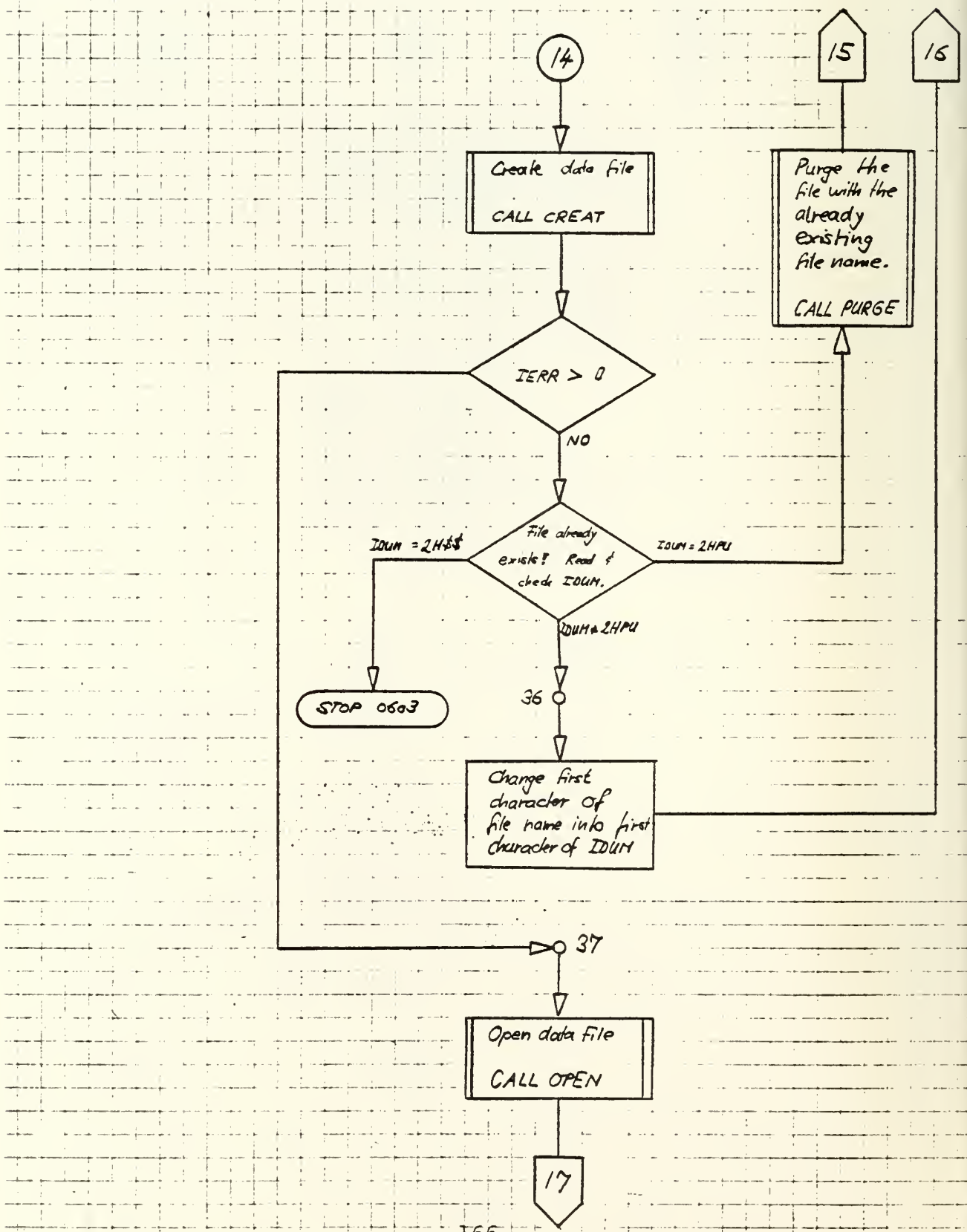

2
3
4
Aquire pressure readings from the S/V - S/V-controller - Scanner - DVM data chain.
S/V #1 (J0 = 1) → raw data array channel 1 (J1 = 1); Define IW
DO 07 J2 = 1, 48, 1
DATA(J2, J1) = ACQN(J0, J2, J1)
07
Display all data & parameters.
DO loop completed?
NO
YES
5
6
7

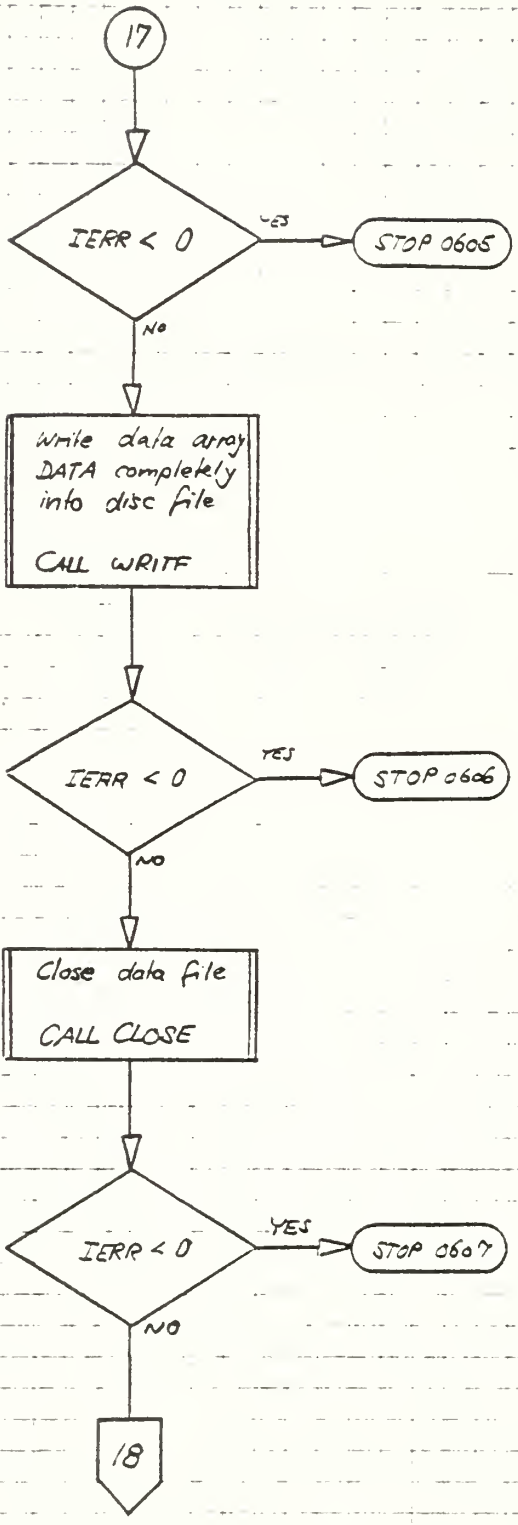

5
6
7
SW #4 (J0 = 4) → raw data array channel 2 (J1 = 2); Define Iw.
DO 08 J2 = 1, 45, 1
DATA(J2, J1) = ACQN(J0, J2, Iw)
08
Display all data & parameters.
DO loop completed?
NO
YES
Subtract tare from pressure readings in order to compensate amplifier drift during test run.
11
8
9

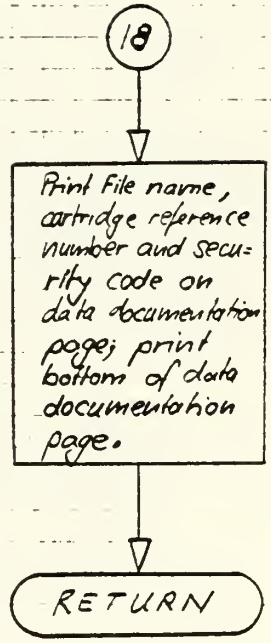

8
9
Acquire data (pressures, temperatures, torque, speed & probe positions) from scanner-DVM system (IC=1) and scanner - counter system (IC=2). Since groups of similar data are seperated by a blank line, this flow chart refrains from mapping all DO loops. First the raw data array channel 3 (JI=3) is filled.
Fill up raw data array channel 4 (JI=4) with data and control variables as read from the control array CNTRL; manually input case angle into DATA(43,JI).
DATA(43,JI) = 9999
YES
STOP 0601
10
11


10
11
Print acquired data; the printout is spaced into blocks of five; if the particular data point is -.999999, "n/a" is printed to indicate, that this point is not being used.
Get date & time and define FMP parameters JSEC1 & JCR.
IDOCF<100
No
YES
Change IFRST from T4 (standard) to S4. Subtract 100 from IDOCF.
IFRST = 2HS4
IDOCF = IDOCF-100
32
12
13


12
13
Define name of the raw data file (IFILE).
34
33
Ask operator whether to repeat this point or terminate the subroutine and return control to the calling program.
IDUM = 2HRP
Read and check IDUM.
=2H$$
STOP 0602
IDUM = 2HRT
STOP 0604
35
YES
Store acquired data in a type 1 disc file
NO
IERR < 0
14
15
16


14
15
16
Create data file
CALL CREAT
Purge the file with the already existing file name.
CALL PURGE
IERR > 0
NO
File already exist? Read & check IDUM.
IDUM = 2H$$
IDUM = 2HPU
IDUM ≠ 2HPU
STOP 0603
36
Change first character of file name into first character of IDUM
37
Open data file
CALL OPEN
17


17
IERR < 0
YES
STOP 0605
NO
write data array DATA completely into disc file
CALL WRITF
IERR < 0
YES
STOP 0606
NO
Close data file
CALL CLOSE
IERR < 0
YES
STOP 0607
NO
18


18
Print File name, cartridge reference number and security code on data documentation page; print bottom of data documentation page.
RETURN

5.4. PROGRAM LISTING TXCO2

```
PAGE 0001  FTN.  4:12 PM  TUE., 23  SEP., 1980

0001  FTN4,L
0002        BLOCK DATA
0003       *, / FMP    / IDCB(144),IFILE(3),ISIZE(2),ISECU,ICR
0004        COMMON / FMP    / IDCB,IFILE,ISIZE,ISECU,ICR
0005        INTEGER IDCB(144),IFILE(3),ISIZE(2)
0006        END

 FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)
 **  NO WARNINGS **  NO ERRORS **
BLOCK COMMON FMP     SIZE =  00151
```

```
 PAGE 0002  FTN.   4:12 PM  TUE., 23  SEP., 1980

0007          BLOCK DATA
0008         *,  / CIBUF / IFUF(1664)
0009          COMMON / CIBUF / IBUF
0010          INTEGER IBUF(1664)
0011          END

  FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)
  **  NO WARNINGS **  NO ERRORS **
 BLOCK COMMON CIBUF   SIZE =  01664
```

```
PAGE 0003  FTN.   4:12 PM  TUE., 23  SEP., 1980

0012          BLOCK DATA
0013         *, / CONTR / CNTRL(256)

0014          COMMON / CONTR / CNTRL
0015          INTEGER CNTRL(256)
0016          END

 FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)
 ** NO WARNINGS **  NO ERRORS **
BLOCK COMMON CONTR  SIZE =  00256
```

```
0017          PROGRAM TXCO2 (3,99)
0018    C     .....................................................................
0019    C     .                                                                   .
0020    C     .  The operating system RTE IV B requests the data acquisition      .
0021    C     .  program TXCO for the one stage transsonic compressor to be       .
0022    C     .  split into several programs scheduled by the father program      .
0023    C     .  TXCO.  This son program TXCO2 consists of the subroutines        .
0024    C     .  COMB and STDY.  These codes handle the acquisition of the        .
0025    C     .  steady state data and a survey conducted with the combination    .
0026    C     .  probe.  The data transfer between father and son program         .
0027    C     .  takes place via the control array CNTRL (disc file CNTRLF)       .
0028    C     .  and the data array IBUF (disc file IBUFF).                       .
0029    C     .                                                                   .
0030    C     .  The utility subroutines ACQN, CNTL, CURVE, ICON, IPORT,          .
0031    C     .  PICTR, REWRF, RPACE, SCANR, TIME and WAIT are added.             .
0032    C     .                                                                   .
0033    C     .  Author:    Hans M. Zebner                                        .
0034    C     .  Date  :    March 12, 1980                                        .
0035    C     .                                                                   .
0036    C     .  A detailed program description is available in the TXCO log.     .
0037    C     .                                                                   .
0038    C     .....................................................................
0039         *, Second son program of father program TXCO.

0040
0041          COMMON / CONTR / CNTRL
0042
0043          INTEGER CNTRL(256)
0044
0045          DATA NOLF /006537/
0046
0047      101 FORMAT (9X""20X""A2)
0048      102 FORMAT ("  TXCO2 : PROGRAM ABORTED!  NO SUBROUTINE HAS BE
0049         *EN INITIALIZED.")
0050      801 FORMAT ("CA")
0051     1001 FORMAT ("F1R7M3A1H0T3")
0052     1201 FORMAT ("PF4G6T")
0053     1501 FORMAT ("CA")
0054
0055          CALL REWRF (-1,2)
0056          LI = CNTRL(19)
0057          IF ( CNTRL(50)  .LT.  5   .OR.   CNTRL(50)  .GT.  6 ) GO TO 03
0058
0059    C     .....................................................................
0060    C     .                                                                   .
0061    C     .  Set interface bus and devices to remote control.                 .
0062    C     .                                                                   .
0063    C     .....................................................................
0064          CALL ABRT (7,2)
0065          CALL RMOTE ( 8)
0066          CALL RMOTE (10)
0067          CALL RMOTE (12)
0068          CALL RMOTE (15)
0069          WRITE ( 8, 801)
0070          WRITE (10,1001)
0071          WRITE (12,1201)
0072          WRITE (15,1501)
0073
0074    C     .....................................................................
0075    C     .                                                                   .
0076    C     .  Call subroutine indicated by CNTRL(50).                          .
0077    C     .                                                                   .
0078    C     .....................................................................
0079          ISTOP = CNTRL(50)
0080          IF ( CNTRL(50)  .EQ.  5 ) CALL COMB
0081          IF ( CNTRL(50)  .EQ.  6 ) CALL STDY(CNTRL(51))
0082
0083    C     .....................................................................
0084    C     .                                                                   .
0085    C     .  Release interface bus and devices from remote control.           .
0086    C     .                                                                   .
0087    C     .....................................................................
0088          CALL CLEAR (7,1)
0089          CALL LOCL (7)
0090
0091          CALL REWRF (1,2)
```

```
PAGE 0005  TXC02  4:12 PM  TUE., 23  SEP., 1980

0092          WRITE (LI, 101) NOLF
0093          GO TO (01,02) ISTOP
0094       01 STOP 0577
0095       02 STOP 0677
0096       03 WRITE (LI, 102)
0097          END


 FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

 **  NO WARNINGS **  NO ERRORS **   PROGRAM = 00221      COMMON = 00000
```

```
0098          SUBROUTINE COMB
0099    C     .....................................................................
0100    C     .                                                                   .
0101    C     .  Acquires data from the transsonic 1-stage axial compressor.      .
0102    C     .  Gathers data required for a probe survey with the                .
0103    C     .  combination probe.  The raw data then are transferred to         .
0104    C     .  the HP 9830 calculator for reduction.                            .
0105    C     .                                                                   .
0106    C     .....................................................................
0107          *, Takes data from the combination probe.
0108           COMMON / CIBUF / IBUF
0109           COMMON / CONTR / CNTRL
0110           COMMON / FMP   / IDCB,IFILE,ISIZE,ISECU,ICR
0111           REAL PDAT(21,24),POS(7)
0112           INTEGER CNTRL(256),IDCB(144),IFILE(3),ISIZE(2)
0113           INTEGER IBUF(1664)
0114           INTEGER NOLF,NOCR(2),ICLR(3)
0115           EQUIVALENCE (IBUF(1),PDAT(1,1))
0116           DATA NOLF  /006537B/
0117           DATA NOCR  /000033B,040433B/
0118           DATA ICLR  /015524B,015515B,006537B/
0119           DATA IDCBS /144/
0120    C      FORMATS  COMB START
0121      100 FORMAT (A1"S")
0122      101 FORMAT ("WARNING: file "3A2" already exists!  Type PU to "
0123         *"allow purge or enter any char-",
0124         */,"          acter but T to change file name."38X)
0125      102 FORMAT ("File name change succesful! "3A2" changed to "3A2)
0126      103 FORMAT (""29X"gathering probe data!"29X""A2)
0127      105 FORMAT (""26X"storing data in file "3A2,26X""A2)
0128      107 FORMAT (A2)
0129      210 FORMAT ("  Make sure, that the 9830 receiver program runs!  Ty
0130         *pe YES to continue:"2A2)
0131      211 FORMAT (" "27X"Transferring data to 9830"27X""2A2)
0132      212 FORMAT (" "79X/2A2"  Data transfer completed.  Print transferr
0133         *ed data?  Enter LU# or NO!     "2A2)
0134      213 FORMAT ("  Repeat data transfer?  Enter YES or NO!
0135         *     "2A2)
0136      215 FORMAT ("  Waiting for 9830 storage procedure.  Type C
0137         *R to continue!    "2A2)
0138      216 FORMAT ("  Check synchronisation of master and slave program!
0139         * Type CR to continue!      "2A2)
0140      116 FORMAT (" "16X"Probe survey at this constellation completed"17
0141         *X""A2//
0142         *"Type  TR  to transfer the data to HP 9830 calculator"/
0143         *"      ST  to save the Data in HP 21MX disc file "3A2":"A2
0144         *":"A2/
0145         *"        "2A2)
0146      117 FORMAT (" "25X"Check raw data of this scan!"26X""A2//
0147         *"Type  RE  to repeat this point"/
0148         *"      NE  to proceed to the next point"/
0149         *"      EN  to terminate the survey at this constellation"/
0150         *"        "2A2)
0151      118 FORMAT (21X"Immersion"11X"Yaw Angle"/
0152         *24X"inches"19X" "/
0153         *"  Combination probe "F10.3,10X,F10.3""/
0154         *"      Type 'A' probe "F10.3,10X,F10.3""/
0155         *"      Type 'B' probe "F10.3,10X,F10.3""//
0156         *"          Case angle "20X""F10.3""//
0157         *"Type  UP  to update those readings"/
0158         *"      TA  to take a data set at this constellation"/
0159         *"        "2A2)
0160      119 FORMAT (" Enter case angle"34X,2A2)
0161      120 FORMAT ("  Is this combination probe survey done before (",
0162         *"1) or after (2) the rotor? "2A2)
0163      121 FORMAT (" PDAT("I2","I2") = ACQN("I2","I2","I3")    has been e
0164         *xecuted;  result is "F10.6""A2)
0165      122 FORMAT (" PDAT("I2","I2") = SCANR("I2","I2","I1")     has been exe
0166         *cuted;  result is "F10.6""A2)
0167      147 FORMAT (I1)
0168      148 FORMAT (I2)
0169      149 FORMAT ((3A2))
0170      189 FORMAT ((21F6.4))
0171      601 FORMAT (1H ,"",/////,36X
0172         *,"Probe Survey Documentation Page:
```

```
0173          */////)
0174       602 FORMAT (1H ,45(1H ),33HTranssonic Compressor Test Run # ,I7)
0175       603 FORMAT (1H ,58(1H ),6HDate:  ,A2,1H/,A2,1H/,A2)
0176       604 FORMAT (1H ,"",58(1H ),6HTime:  ,A2,1H.,A2,3H  h,/////)
0177       605 FORMAT (1H0,"Constellation #"I3""//1H ,9F10.6/
0178          *1H ,60X,3F10.6/1H ,70X,2F10.6/1H ,20X,2F10.6,F10.1,4I10/)
0179       606 FORMAT (1H0,"Data transferred to HP 9830 file "10X".")
0180       607 FORMAT (1H0,"Data saved in file "3A2":"A2":"A2".")
0181       610 FORMAT ("
```

",58(1H),6HTime: ,A2,1H.,A2,3H h)

```
0182     701 FORMAT (I13)
0183     702 FORMAT (F13.6)
0184     900 FORMAT (" A REGISTER IS "K6"       B REGISTER IS "K6/)
0185    1001 FORMAT ("F1R7M3A1H0T3")
0186    1201 FORMAT ("PF4G6T")
0187  C      FORMATS  COMB STOP
0188         IF ( IENTR  .NE.  0 ) GO TO 7211
0189         IENTR = 1
0190         IDOC  = 0
0191         IDOCF = 0
0192         ISECU = CNTRL(31)
0193         ICR   = CNTRL(30)
0194         ITYPE = 1
0195         IL    = 1024
0196         ISIZE(1) = 8
0197         ISIZE(2) = 128
0198         LI = CNTRL(19)
0199    7211 IDOC  = IDOC+1
0200    7213 WRITE (LI, 120) NOCR
0201         READ  (LI,   *) IPOS
0202         WRITE (LI, 149) ICLR
0203         IF ( IPOS  .LT.  1   .OR.  IPOS  .GT.  2 ) GO TO 7213
0204         IDOCF = IDOCF+1
0205         DO 7212 I=1,1024,1
0206    7212 IBUF(I)=0
0207         WRITE (10,1001)
0208         WRITE (12,1201)
0209         LO = CNTRL(20)
0210         CALL TIME (IMON,IDAY,IYEAR,IHOUR,IMIN)
0211         WRITE (LO,602) CNTRL(4)
0212         WRITE (LO,603) IMON,IDAY,IYEAR
0213         WRITE (LO,604) IHOUR,IMIN
0214         WRITE (LO,601)
0215         J1 = 0
0216      20 J1 = J1+1
0217      25 IS = 8CNTRL(Y1)
0218         IC = 1
0219         I2 = 1
0220         IF ( IPOS  .EQ.  2 ) J3 = 30
0221         IF ( IPOS  .EQ.  1 ) J3 = 38
0222         POS(I2) = SCANR(IS,J3,IC)
0223         I2 = I2+1
0224         IF ( IPOS  .EQ.  2 ) J3 = 31
0225         IF ( IPOS  .EQ.  1 ) J3 = 39
0226         POS(I2) = SCANR(IS,J3,IC)
0227         I2 = I2+1
0228         DO 21 J3=32,35,1
0229         POS(I2) = SCANR(IS,J3,IC)
0230      21 I2 = I2+1
0231         DO 22 I2=1,5,2
0232      22 POS(I2) = POS(I2)*1000.
0233         DO 23 I2=2,6,2
0234      23 POS(I2) = POS(I2)*10000.
0235         WRITE (LI, 119) NOCR
0236         READ  (LI,   *) POS(7)
0237         WRITE (LI, 149) ICLR
0238      24 WRITE (LI, 118) (POS(I2),I2=1,7),NOCR
0239         READ  (LI, 149) IDUM
0240         WRITE (LI, 149) (ICLR,I=1,11)
0241         IF ( IDUM  .EQ.  2HTA ) GO TO 4711
0242         IF ( IDUM  .EQ.  2HUP ) GO TO 25
0243         GO TO 24
0244    4711 IW = CNTRL(250)
0245         WRITE (LI, 103) NOLF
0246  C      .....................................................
0247  C      .
```

```
0248  C      . Gather data recorded via S/V#1 (J0=1).                          .
0249  C      .                                                                 .
0250  C      ...................................................................
0251           J0 = 1
0252           J3 = 7
0253           J2 = 6
0254           PDAT(J2,J1) = ACQN(J0,J3,IW)
0255           WRITE (LI, 121) J2,J1,J0,J3,IW,PDAT(J2,J1),NOLF
0256           J3 = 9
0257           J2 = 7
0258           PDAT(J2,J1) = ACQN(J0,J3,IW)
0259           WRITE (LI, 121) J2,J1,J0,J3,IW,PDAT(J2,J1),NOLF
0260           J3 = 20
0261           J2 = 8
0262           PDAT(J2,J1) = ACQN(J0,J3,IW)
0263           WRITE (LI, 121) J2,J1,J0,J3,IW,PDAT(J2,J1),NOLF
0264           SUM = 0.
0265           DO 1 J3=30,33
0266           J2 = 9
0267           PDAT (J2,J1) = ACQN(J0,J3,IW)
0268           WRITE (LI, 121) J2,J1,J0,J3,IW,PDAT(J2,J1),NOLF
0269         1 SUM = SUM+PDAT(J2,J1)
0270           PDAT(J2,J1) = SUM/4.
0271  C      ...................................................................
0272  C      .                                                                 .
0273  C      .  Gather data recorded via S/V#4 (J0=4).                         .
0274  C      .                                                                 .
0275  C      ...................................................................
0276           J0 = 4
0277           IF ( IPOS  .EQ.  2 ) J3 = 3
0278           IF ( IPOS  .EQ.  1 ) J3 = 7
0279           J2 = 3
0280           PDAT(J2,J1) = ACQN(J0,J3,IW)
0281           WRITE (LI, 121) J2,J1,J0,J3,IW,PDAT(J2,J1),NOLF
0282           IF ( IPOS  .EQ.  2 ) J3 = 4
0283           IF ( IPOS  .EQ.  1 ) J3 = 8
0284           J2 = 4
0285           PDAT(J2,J1) = ACQN(J0,J3,IW)
0286           WRITE (LI, 121) J2,J1,J0,J3,IW,PDAT(J2,J1),NOLF
0287           IF ( IPOS  .EQ.  2 ) J3 = 5
0288           IF ( IPOS  .EQ.  1 ) J3 = 9
0289           J2 = 5
0290           PDAT(J2,J1) = ACQN(J0,J3, 1)
0291           WRITE (LI, 121) J2,J1,J0,J3,IW,PDAT(J2,J1),NOLF
0292  C      ...................................................................
0293  C      .                                                                 .
0294  C      .  Gather data recorded via scanner#1 (IS=8).                     .
0295  C      .                                                                 .
0296  C      ...................................................................
0297           IS = 8
0298           IC = 2
0299           J3 = 17
0300           J2 = 18
0301           PDAT(J2,J1) = SCANR(IS,J3,IC)
0302           WRITE (LI, 122) J2,J1,IS,J3,IC,PDAT(J2,J1),NOLF
0303           IC = 1
0304           J3 = 25
0305           J2 = 1
0306           PDAT(J2,J1) = SCANR(IS,J3,IC)
0307           WRITE (LI, 122) J2,J1,IS,J3,IC,PDAT(J2,J1),NOLF
0308           J3 = 26
0309           J2 = 10
0310           PDAT(J2,J1) = SCANR(IS,J3,IC)
0311           WRITE (LI, 122) J2,J1,IS,J3,IC,PDAT(J2,J1),NOLF
0312           J3 = 27
0313           J2 = 12
0314           PDAT(J2,J1) = SCANR(IS,J3,IC)
0315           WRITE (LI, 122) J2,J1,IS,J3,IC,PDAT(J2,J1),NOLF
0316           IF ( IPOS  .EQ.  2 ) J3 = 30
0317           IF ( IPOS  .EQ.  1 ) J3 = 38
0318           J2 = 15
0319           PDAT(J2,J1) = SCANR(IS,J3,IC)
0320           WRITE (LI, 122) J2,J1,IS,J3,IC,PDAT(J2,J1),NOLF
0321           IF ( IPOS  .EQ.  2 ) J3 = 31
0322           IF ( IPOS  .EQ.  1 ) J3 = 39
```

```
0323          J2 = 16
0324          PDAT(J2,J1) = SCANR(IS,J3,IC)
0325          WRITE (LI, 122) J2,J1,IS,J3,IC,PDAT(J2,J1),NOLF
0326          J3 = 37
0327          J2 = 2
0328          PDAT(J2,J1) = SCANR(IS,J3,IC)
0329          WRITE (LI, 122) J2,J1,IS,J3,IC,PDAT(J2,J1),NOLF
0330    C     ..................................................................
0331    CC    .                                                                .
0332    CC    .  Gather data recorded via scanner#2 (IS=15).                   .
0333    CC    .                                                                .
0334    C     ..................................................................
0335          IS = 15
0336          J2 = 11
0337          SUM = 0.
0338          DO 2 J3=4,5
0339          PDAT(J2,J1) = SCANR(IS,J3,IC)
0340          WRITE (LI, 122) J2,J1,IS,J3,IC,PDAT(J2,J1),NOLF
0341        2 SUM = SUM+PDAT(J2,J1)
0342          PDAT(J2,J1) = SUM/2.
0343          J3 = 18
0344          J2 = 13
0345          PDAT(J2,J1) = SCANR(IS,J3,IC)
0346          WRITE (LI, 122) J2,J1,IS,J3,IC,PDAT(J2,J1),NOLF
0347          J3 = 19
0348          J2 = 14
0349          PDAT(J2,J1) = SCANR(IS,J3,IC)
0350          WRITE (LI, 122) J2,J1,IS,J3,IC,PDAT(J2,J1),NOLF
0351    C     ..................................................................
0352    CC    .                                                                .
0353    CC    .  Gather the rest of the required data.                         .
0354    CC    .                                                                .
0355    C     ..................................................................
0356          PDAT(19,J1) = CNTRL(4)
0357          PDAT(20,J1) = CNTRL(5)
0358          PDAT(21,J1) = CNTRL(6)
0359          PDAT(17,J1) = POS(7)
0360          WRITE (LO, 605) J1,(PDAT(I,J1),I=1,21)
0361       50 WRITE (LI, 117) NOLF,NOCR
0362          READ  (LI, 149) IDUM
0363          WRITE (LI, 149) (ICLR,I=1,6)
0364          IF ( IDUM  .EQ.  2HRE ) GO TO 4711
0365          IF ( IDUM  .EQ.  2HNE ) GO TO 20
0366          IF ( IDUM  .EQ.  2HEN ) GO TO 51
0367          GO TO 50
0368       51 IFILE(1) = 2HT5
0369          IFILE(2) = ICON(CNTRL(4),0)
0370          IFILE(3) = ICON(IDOCF,0)
0371          JSECU = ICON(ISECU,0)
0372          JCR   = ICON(ICR,0)
0373          WRITE (LI, 116) NOLF,IFILE,JSECU,JCR,NOCR
0374          READ  (LI, 149) IDUM
0375          WRITE (LI, 149) (ICLR,I=1,5)
0376          IF ( IDUM  .EQ.  2HTR ) GO TO 52
0377          IF ( IDUM  .EQ.  2HST ) GO TO 53
0378          GO TO 51
0379       52 ISYNCH = 9830
0380    C     ..................................................................
0381    CC    .                                                                .
0382    CC    .  Data transfer to HP 9830 for reduction.  No storage on 21MX!  .
0383    CC    .                                                                .
0384    C     ..................................................................
0385       71 WRITE (LI, 210) NOCR
0386          READ  (LI, 149) IDUM
0387          WRITE (LI, 149) ICLR
0388          IF ( IDUM  .NE.  2HYE ) GO TO 71
0389          WRITE ( 7, 701) ISYNCH
0390          WRITE (LI, 216) NOCR
0391          READ  (LI,   *) IDUM
0392          WRITE (LI, 149) ICLR
0393          WRITE (LI, 211) NOLF
0394          DO 72 I=1,21
0395          DO 72 J=1,24
0396       72 WRITE ( 7, 702) PDAT(I,J)
0397          WRITE (LO, 189) ((PDAT(I,J),I=1,21),J=1,24)
```

```
0398          WRITE (LI, 149) ICLR
0399          WRITE (LI, 215) NOCR
0400          READ  (LI,   *) IDUM
0401          WRITE (LI, 149) ICLR
0402          WRITE (LO, 606)
0403          GO TO 66
0404    C     ..................................................................
0405    C     .                                                                .
0406    C     .  Save data on 21MX disc.  No transfer to HP 9830.              .
0407    C     .                                                                .
0408    C     ..................................................................
0409       53 CONTINUE
0410      418 WRITE (LI,105) (IFILE(J2),J2=1,3),NOLF
0411          CALL CREAT (IDCB,IERR,IFILE,ISIZE,ITYPE,ISECU,ICR,IDCBS)
0412          IF ( IERR  .GT.  0 ) GO TO 420
0413          WRITE (LI,101) (IFILE(J2),J2=1,3)
0414          READ  (LI,107) IDUM
0415          WRITE (LI,149) ICLR
0416          IF ( IDUM  .NE.  2HPU ) GO TO 419
0417          CALL PURGE (IDCB,IERR,IFILE,ISECU,ICR)
0418          IF ( IERR  .LT.  0 ) STOP 15
0419          GO TO 418
0420      419 CALL CODE
0421          WRITE (NEW,100) IDUM
0422          WRITE (LI,102) (IFILE(J2),J2=1,3),NEW,(IFILE(J2),J2=2,3)
0423          IFILE(1) = NEW
0424          GO TO 418
0425      420 CALL OPEN  (IDCB,IERR,IFILE,IOPTN,ISECU,ICR,IDCBS)
0426          IF ( IERR  .LT.  0 ) STOP 16
0427          CALL WRITF (IDCB,IERR,PDAT,IL)
0428          IF ( IERR  .LT.  0 ) STOP 17
0429          CALL CLOSE (IDCB,IERR,0)
0430          IF ( IERR  .LT.  0 ) STOP 20
0431          WRITE (LI,149) ICLR
0432          WRITE (LO, 607) IFILE,JSECU,JCR
0433       66 CALL TIME (IMON,IDAY,IYEAR,IHOUR,IMIN)
0434          WRITE (LO,610) IHOUR,IMIN
0435          RETURN
0436          END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 03462 COMMON = 00000

```
0437          SUBROUTINE STDY (IRUN)
0438    C     .....................................................
0439    C     .                                                   .
0440    C     .  Acquires data from the transsonic 1-stage axial compressor.
0441    C     .  This subroutine takes care of the steady state.data, either
0442    C     .  in a long or a short run (IRUN=1 resp. 0).       .
0443    C     .                                                   .
0444    C     .....................................................
0445         *, Takes data from steady state system.

0446          COMMON / CIBUF / IBUF
0447          COMMON / CONTR / CNTRL
0448          COMMON / FMP   / IDCB,IFILE,ISIZE,ISECU,ICR
0449          INTEGER IBUF(1664),ITIME(5),IDATA(8,4),NO(2),NOLF,NOCR(2),ICLR(3)
0450          INTEGER IDCB(144),IFILE(3),ISIZE(2)
0451          INTEGER CNTRL(256)
0452          REAL DATA(48,4)
0453          EQUIVALENCE (IBUF(1),DATA(1,1))
0454          DATA NOLF  /006537B/
0455          DATA NOCR  /000033B,040433B/
0456          DATA ICLR  /015524B,015515B,006537B/
0457    C     FORMATS STDY START
0458      100 FORMAT (A1"4")
0459      101 FORMAT ("WARNING: File "3A2" already exists!  Type ",
0460         *"PU to allow purge or enter any char-",
0461         */."                acter but T to change file name."38X)
0462      102 FORMAT ("  STDY  : File name "3A2" succesfully changed to "3A2)
0463      103 FORMAT ("  STDY  : PU,"3A2":"A2":"A2)
0464      104 FORMAT (I2)
0465      105 FORMAT (""26X"storing data in file "3A2,26X""A2)
0466      106 FORMAT (" Enter case angle  :  "R1"J"2A2)
0467      110 FORMAT (/"Look at the just acquired data! Decide and enter"//
0468         *"RP  ...  to repeat the data acquisition"/
0469         *"RT  ...  to return to the calling program"//
0470         *"  "A2)
0471      112 FORMAT (/"Do you want"//
0472         *"0  ...  a short run"/
0473         *"1  ...  a long run"//" "A2)
0474      115 FORMAT (4F16.6)
0475      120 FORMAT (" DATA("I2","I1") = ACQN("I1","I2","I3")    has been execu
0476         *ted;  result is "F10.6""A2)
0477      121 FORMAT (" DATA("I2","I1") = SCANR("I2","I2","I1")    has been exec
0478         *eted;  result is "F10.6""A2)
0479      147 FORMAT (I1)
0480      149 FORMAT ((3A2))
0481      601 FORMAT (1H ,"",/////,36X
0482         *,"Steady State Data Documentation
0483         */////)
0484      602 FORMAT (1H ,45(1H ),33HTranssonic Compressor Test Run # ,I7)
0485      603 FORMAT (1H ,58(1H ),6HDate: ,A2,1H/,A2,1H/,A2)
0486      604 FORMAT (1H ,"",58(1H ),6HTime: ,A2,1H.,A2,3H  h,/////)
0487      605 FORMAT (1H ,46(1H ),""4I15"")
0488      606 FORMAT (1H ,36(1H ),I2,8(1H ),""4(A1,7A2)"",I7)
0489      607 FORMAT (1H ,46(1H ),4(A1,7A2))
0490      608 FORMAT (1H ,36(1H ),I2,8(1H ),4(A1,7A2),I7)
0491      609 FORMAT (1H ,46(1H ),4I15,//)
0492      610 FORMAT (1H ,36X,  "Long run performed.  Above printed data are sav
0493         *ed in file "3A2":"A2":"I2,/
0494         *1H ,36X,"Note : "2A2" ... no data acquired.")
0495      611 FORMAT (1H ,36X,  "Short run performed.  Above printed data are sa
0496         *ved in file "3A2":"A2":"I2,/
0497         *1H ,36X,"Note : "2A2" ... no data acquired.")
0498      612 FORMAT ("
```

",58(1H),6HTime: ,A2,1H.,A2,3H h,/////)

```
0499     900 FORMAT (" A REGISTER IS "K6"       B REGISTER IS "K6/)
0500    1001 FORMAT ("F1R7M3A1H0T3")
0501    1201 FORMAT ("PF4G6T")
0502  C      FORMATS  STUDY  STOP
0503         IF ( IENTR  .NE.  0 ) GO TO  1
0504         IENTR     = 1
0505         IDOC      = 0
0506         IDOCF     = 0
0507         ISECU     = CNTRL(31)
0508         ICR       = CNTRL(30)
0509         ITYPE     = 1
0510         IL        = 384
0511         IDCBS     = 144
```

```
0512      01 ISIZE(1) = 3
0513         ISIZE(2) = 128
0514         WRITE (10,1001)
0515         WRITE (12,1201)
0516         IFRST    = 2HT4
0517         LI       = CNTRL(19)
0518         LO       = CNTRL(20)
0519         CALL TIME (IMON,IDAY,IYEAR,IHOUR,IMIN)
0520         WRITE (LO,602) CNTRL(4)
0521         WRITE (LO,603) IMON,IDAY,IYEAR
0522         WRITE (LO,604) IHOUR,IMIN
0523         WRITE (LO,601)
0524         IDOC  = 1+IDOC
0525         IDOCF = 1+IDOCF
0526      05 WRITE (10,1001)
0527   C     .....................................................................
0528   C     .                                                                   .
0529   C     . Preset data array DATA(48,4) with the dummy variable -.999999     .
0530   C     . to make trouble shooting easier.                                  .
0531   C     .                                                                   .
0532   C     .....................................................................
0533         DO 06 J1=1,4,1
0534         DO 06 J2=1,48,1
0535      06 DATA(J2,J1) = -0.999999
0536         IF ( IRUN  .EQ.  0 ) GO TO 11
0537   C     .....................................................................
0538   C     .                                                                   .
0539   C     .  Acquire pressures from scannivalve-scanner-DVM system.  Only     .
0540   C     .  performs in a long run.                                          .
0541   C     .                                                                   .
0542   C     .....................................................................
0543         J0    = 1
0544         J1    = 1
0545         IW    =  CNTRL(250)
0546         DO 07 J2=1,48,1
0547         DATA(J2,J1) = ACQN(J0,J2,IW)
0548      07 WRITE (LI, 120) J2,J1,J0,J2,IW,DATA(J2,J1),NOLF
0549         J0    = 4
0550         J1    = 2
0551         IW    = CNTRL(250)
0552         DO 08 J2=1,45,1
0553         DATA(J2,J1) = ACQN(J0,J2,IW)
0554      08 WRITE (LI, 120) J2,J1,J0,J2,IW,DATA(J2,J1),NOLF
0555   C     .....................................................................
0556   C     .                                                                   .
0557   C     .  Subtract tare from pressure readings.                            .
0558   C     .                                                                   .
0559   C     .....................................................................
0560         TARE1       = DATA( 1, 1)
0561         TARE2       = DATA( 1, 2)
0562         J1 = 1
0563         DO 09 J2=1,48,1
0564      09 DATA(J2,J1) = DATA(J2,J1)-TARE1
0565         J1 = 2
0566         DO 10 J2=1,45,1
0567      10 DATA(J2,J1) = DATA(J2,J1)-TARE2
0568   C     .....................................................................
0569   C     .                                                                   .
0570   C     .  Acquire data (pressures, temperatures, torque, speed, probe      .
0571   C     .  positions) from scanner-DVM or scanner-counter system.           .
0572   C     .                                                                   .
0573   C     .....................................................................
0574      11 J1 = 3
0575         IS = 8
0576         IC = 1
0577         J3 = 25
0578         DO 12 J2=1,5,1
0579         DATA(J2,J1) = SCANR(IS,J3,IC)
0580         WRITE (LI, 121) J2,J1,IS,J3,IC,DATA(J2,J1),NOLF
0581      12 J3 = J3+1
0582         J3 = 30
0583         DO 13 J2=7,12,1
0584         DATA(J2,J1) = SCANR(IS,J3,IC)
0585         WRITE (LI, 121) J2,J1,IS,J3,IC,DATA(J2,J1),NOLF
0586      13 J3 = J3+1
```

```
0587          J3 = 0
0588          IS = 15
0589          DO 14 J2=14,17,1
0590          DATA(J2,J1) = SCANR(IS,J3,IC)
0591          WRITE (LI, 121) J2,J1,IS,J3,IC,DATA(J2,J1),NOLF
0592       14 J3 = J3+1
0593          J3 = 4
0594          DO 15 J2=19,25,1
0595          DATA(J2,J1) = SCANR(IS,J3,IC)
0596          WRITE (LI, 121) J2,J1,IS,J3,IC,DATA(J2,J1),NOLF
0597       15 J3 = J3+1
0598          J3 = 12
0599          DO 16 J2=27,31,1
0600          DATA(J2,J1) = SCANR(IS,J3,IC)
0601          WRITE (LI, 121) J2,J1,IS,J3,IC,DATA(J2,J1),NOLF
0602       16 J3 = J3+1
0603          IS = 8
0604          J3 = 37
0605          J2 = 33
0606          DATA(J2,J1) = SCANR(IS,J3,IC)
0607          WRITE (LI, 121) J2,J1,IS,J3,IC,DATA(J2,J1),NOLF
0608          IS = 15
0609          J3 = 40
0610          DO 17 J2=34,45,1
0611          DATA(J2,J1) = SCANR(IS,J3,IC)
0612          WRITE (LI, 121) J2,J1,IS,J3,IC,DATA(J2,J1),NOLF
0613       17 J3 = J3+1
0614          J3 = 52
0615          DO 18 J2=47,48,1
0616          DATA(J2,J1) = SCANR(IS,J3,IC)
0617          WRITE (LI, 121) J2,J1,IS,J3,IC,DATA(J2,J1),NOLF
0618       18 J3 = J3+1
0619          IS = 8
0620          IC = 2
0621          J1 = 4
0622          J3 = 19
0623          J2 = 45
0624          DATA(J2,J1) = SCANR(IS,J3,IC)
0625          WRITE (LI, 121) J2,J1,IS,J3,IC,DATA(J2,J1),NOLF
0626          J3 = 17
0627          J2 = 46
0628          DATA(J2,J1) = SCANR(IS,J3,IC)
0629          WRITE (LI, 121) J2,J1,IS,J3,IC,DATA(J2,J1),NOLF
0630          IC = 1
0631          J3 = 36
0632          J2 = 47
0633          DATA(J2,J1) = SCANR(IS,J3,IC)
0634          WRITE (LI, 121) J2,J1,IS,J3,IC,DATA(J2,J1),NOLF
0635          IS = 15
0636          J3 = 19
0637          J2 = 29
0638          DATA(J2,J1) = SCANR(IS,J3,IC)
0639          WRITE (LI, 121) J2,J1,IS,J3,IC,DATA(J2,J1),NOLF
0640          J3 = 20
0641          J2 = 30
0642          DATA(J2,J1) = SCANR(IS,J3,IC)
0643          WRITE (LI, 121) J2,J1,IS,J3,IC,DATA(J2,J1),NOLF
0644          DATA(33,J1) = CNTRL(  4)
0645          DATA(34,J1) = CNTRL(  5)
0646          DATA(35,J1) = CNTRL(  6)
0647          DATA(36,J1) = CNTRL(  2)
0648          DATA(37,J1) = CNTRL(  1)
0649          DATA(38,J1) = CNTRL(  3)
0650          DATA(39,J1) = CNTRL( 15)
0651          WRITE (LI, 106) NOCR(1),NOCR
0652          READ  (LI,   *) DATA(43,J1)
0653          WRITE (LI, 149) ICLR
0654          IF ( DATA(43,J1)  .EQ. 9999 ) STOP 0601
0655    C     ..................................................................
0656    CC    .                                                                .
0657    CC    .  Print acquired data.                                          .
0658    CC    .                                                                .
0659    C     ..................................................................
0660          NO(1) = 2H n
0661          NO(2) = 2H/a
```

```
0662          WRITE (LO, 605) (J2,J2=1,4)
0663          J1=1
0664          CALL CODE
0665          WRITE (IDATA,115) (DATA(J1,J2),J2=1,4)
0666          DO 20 J2=1,4,1
0667          IF ( DATA(J1,J2)   .NE.  -.999999 ) GO TO 20
0668          IDATA( 7,J2) = NO(1)
0669          IDATA( 8,J2) = NO(2)
0670          DO 19 J3=1,6,1
0671       19 IDATA(J3,J2) = 2H
0672       20 CONTINUE
0673          WRITE (LO, 608) J1,((IDATA(J3,J2),J3=1,8),J2=1,4),J1
0674          DO 26 J1=2,47,1
0675          IF ( (J1/5)*5   .NE.  J1 ) GO TO 23
0676          CALL CODE
0677          WRITE (IDATA,115) (DATA(J1,J2),J2=1,4)
0678          DO 22 J2=1,4,1
0679          IF ( DATA(J1,J2)   .NE.  -.999999 ) GO TO 22
0680          IDATA( 7,J2) = NO(1)
0681          IDATA( 8,J2) = NO(2)
0682          DO 21 J3=1,6,1
0683       21 IDATA(J3,J2) = 2H
0684       22 CONTINUE
0685          WRITE (LO, 606) J1,((IDATA(J3,J2),J3=1,8),J2=1,4),J1
0686          GO TO 26
0687       23 CALL CODE
0688          WRITE (IDATA,115) (DATA(J1,J2),J2=1,4)
0689          DO 25 J2=1,4,1
0690          IF ( DATA(J1,J2)   .NE.  -.999999 ) GO TO 25
0691          IDATA( 7,J2) = NO(1)
0692          IDATA( 8,J2) = NO(2)
0693          DO 24 J3=1,6,1
0694       24 IDATA(J3,J2) = 2H
0695       25 CONTINUE
0696          WRITE (LO, 607) ((IDATA(J3,J2),J3=1,8),J2=1,4)
0697       26 CONTINUE
0698          J1=48
0699          CALL CODE
0700          WRITE (IDATA,115) (DATA(J1,J2),J2=1,4)
0701          DO 28 J2=1,4,1
0702          IF ( DATA(J1,J2)   .NE.  -.999999 ) GO TO 28
0703          IDATA( 7,J2) = NO(1)
0704          IDATA( 8,J2) = NO(2)
0705          DO 27 J3=1,6,1
0706       27 IDATA(J3,J2) = 2H
0707       28 CONTINUE
0708          WRITE (LO, 606) J1,((IDATA(J3,J2),J3=1,8),J2=1,4),J1
0709          WRITE (LO, 609) (J2,J2=1,4)
0710          CALL TIME (IMON,IDAY,IYEAR,IHOUR,IMIN)
0711          JSECU = ICON(ISECU,0)
0712          JCR   = ICON(ICR,0)
0713          IF  ( IDOCF  .LT.  100 ) GO TO 32
0714          IFRST = 2HS4
0715          IDOCF = IDOCF-99
0716       32 IFILE(1) = IFRST
0717          IFILE(2) = ICON(CNTRL(4),0)
0718          IFILE(3) = ICON(IDOCF,0)
0719    C     .....................................................
0720    C     .                                                   .
0721    C     .  Ask operator whether to repeat the data acquisition at this   .
0722    C     .  setting (RP) or to return to the calling program (RT).        .
0723    C     .                                                   .
0724    C     .....................................................
0725       33 WRITE (LI, 110) NOLF
0726          READ  (LI, 149) IDUM
0727          WRITE (LI, 149) (ICLR,I=1,7)
0728          IF ( IDUM  .EQ.  2HRP ) GO TO 34
0729          IF ( IDUM  .EQ.  2HRT ) GO TO 35
0730          IF ( IDUM  .EQ.  2H$$ ) STOP 0602
0731          GO TO 33
0732       34 WRITE (LI, 112) NOLF
0733          READ  (LI, 147) IRUN
0734          WRITE (LI, 149) (ICLR,I=1,7)
0735          WRITE (LO, 612) IHOUR,IMIN
0736          WRITE (LO, 604) IHOUR,IMIN
```

```
0737          GO TO 05
0738    C     ...........................................................
0739    C     .                                                         .
0740    C     .  Store acquired data on a disc type 1 file.             .
0741    C     .                                                         .
0742    C     ...........................................................
0743       35 WRITE (LI, 105) IFILE,NOLF
0744          CALL CREAT (IDCB,IERR,IFILE,ISIZE,ITYPE,ISECU,ICR,IDCBS)
0745          IF ( IERR  .GT.  0 ) GO TO 37
0746          WRITE (LI, 101) IFILE
0747          READ  (LI, 149) IDUM
0748          WRITE (LI, 149) (ICLR,I=1,3)
0749          IF ( IDUM  .EQ.  2H$$ ) STOP 0603
0750          IF ( IDUM  .NE.  2HPU ) GO TO 36
0751          WRITE (LI, 103) IFILE,JSECU,JCR
0752          CALL PURGE (IDCB,IERR,IFILE,ISECU,ICR)
0753          IF ( IERR  .LT.  0 ) STOP 0604
0754          GO TO 35
0755       36 CALL CODE
0756          WRITE (NEW,100) IDUM
0757          WRITE (LI, 102) IFILE,NEW,IFILE(2),IFILE(3)
0758          IFILE(1) = NEW
0759          GO TO 35
0760       37 CALL OPEN  (IDCB,IERR,IFILE,IOPTN,ISECU,ICR,IDCBS)
0761          IF ( IERR  .LT.  0 ) STOP 0605
0762          CALL WRITF (IDCB,IERR,DATA,IL)
0763          IF ( IERR  .LT.  0 ) STOP 0606
0764          CALL CLOSE (IDCB,IERR,0)
0765          IF ( IERR  .LT.  0 ) STOP 0607
0766          IF ( IRUN  .EQ.  1 ) WRITE (LO,610) IFILE,JSECU,ICR,NO
0767          IF ( IRUN  .EQ.  0 ) WRITE (LO,611) IFILE,JSECU,ICR,NO
0768          WRITE (LO,612) IHOUR,IMIN
0769          RETURN
0770          END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 03193 COMMON = 00000

6. PROGRAM TXCO3

6.1. DESCRIPTION

TXCO3 is a son program of the father program TXCOØ, by which it is scheduled if one of the following operations is desired:

7 - Check the instrumentation

8 - Manipulate the program control array CNTRL.

When scheduled by TXCOØ, which suspends operation while the son program TXCO3 executes, the program TXCO3 reads the program control array from the disc, sets the HP interface bus and the measurement and control devices to remote control, preprograms the digital voltmeter (DVM), the scanners and the counter. CNTRL(50) is the actual decision variable to select and call the subroutine, which performs the desired operation. When this subroutine has terminated, the interface bus and the devices are released from remote control and the control array is written into a disc file, so that the next TXCO module can read it. The correct termination of each subroutine can be verified by checking the stop codes. Note that all stop codes ending on 77 indicate correct execution of a subroutine.

CNTRL(50)	Subroutine	STOP Code
7	CHECK	TXCO3 : STOP 0777
8	CHNGE	TXCO3 : STOP 1077

EXTERNALS: REWRF, ABRT, RMOTE, CHECK, CHNGE, CLEAR, LOCL

COMMON BLOCKS: FMP, CIBUF, CONTR.

The FORTRAN-IV compiler for the HP 21 MX computer requests COMMON blocks to be predefined in a BLOCK DATA subroutine prior to using a COMMON block in a program, subroutine or function.

BLOCK DATA Subroutine	Arrays & Variables	Length in Words
FMP	IDCB,IFILE,ISIZE,ISECU,ICR	$227B = 151_{10}$
CIBUF	IBUF	$3200B = 1664_{10}$
CONTR	CNTRL	$400B = 256_{10}$

The arrays and variables allocated by the COMMON block FMP are frequently used for the data transfer from and to the disc. COMMON block CIBUF is designed to take the largest raw data array in the TXCO data acquisition and reduction system - IBUF(1664) in subroutine FREER. The program modules CHECK and CHNGE do not use the complete area allocated by CIBUF. COMMON block CONTR allocates the space for the control array CNTRL.

MNEMONIC ABBREVIATIONS: None

ERROR MESSAGES: If CNTRL(50) is less than 7 or greater than 8, no subroutine has been selected and the program terminates outputting an error message (FORMAT #102) to the standard input device, i.e. the terminal.

PROCEDURE: For more detailed information, study the flow chart and the information given in the subroutine descriptions.

DATA FILE: None

VARIABLES IN BLOCK DATA FMP:

ICDB (144)	integer	data control block
IFILE (3)	integer	array to contain file name
ISIZE (2)	integer	array to contain # of records in the first and record length in 16-bit-words in the second word
ISECU	integer	security code of data file
ICR	integer	cartridge reference number, where data file is located

VARIABLES IN BLOCK DATA CIBUF:

IBUF (1664)	integer	buffer array for the raw data

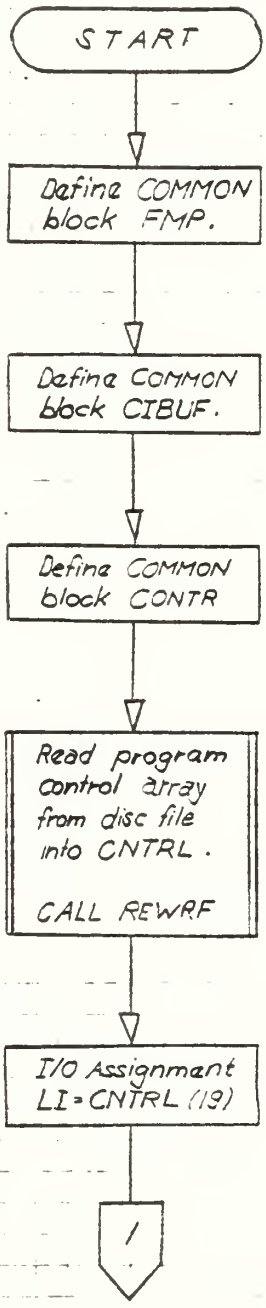
VARIABLES IN BLOCK DATA CONTR:

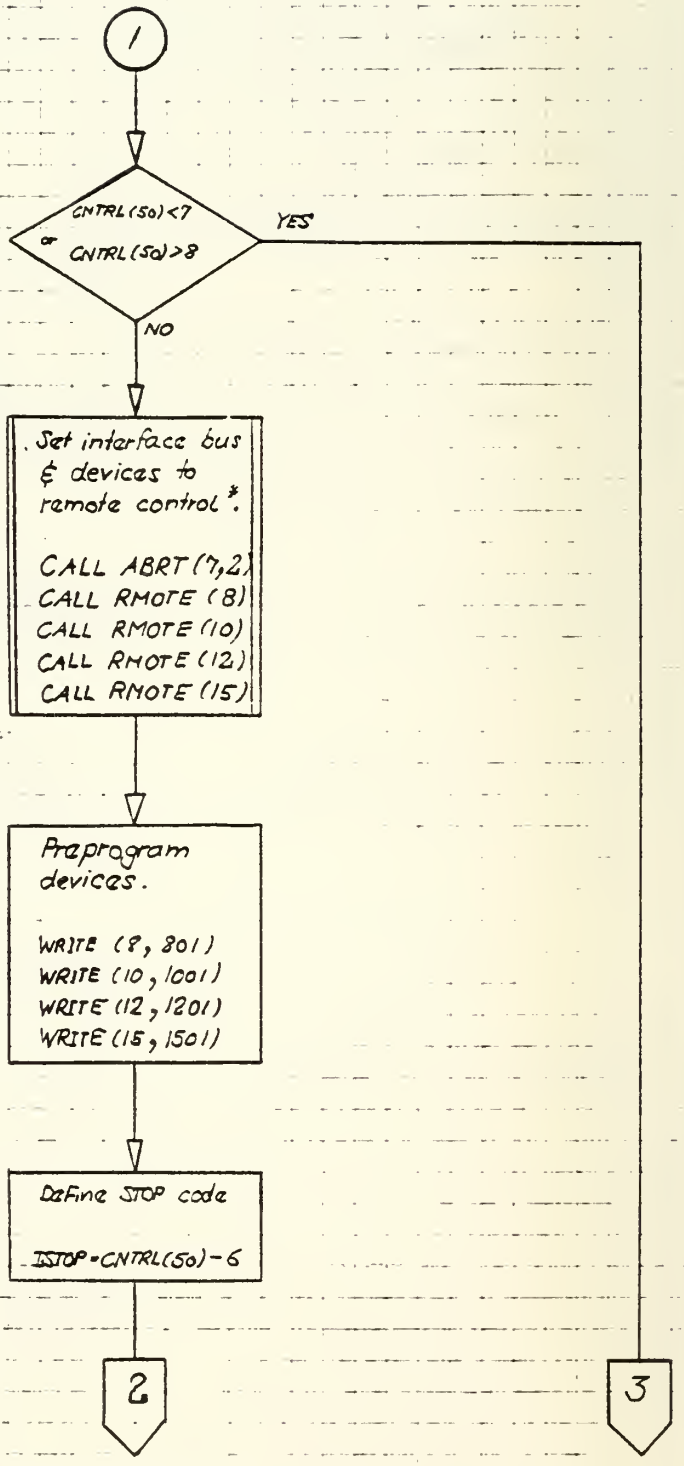
CNTRL (256)	integer	program control array

VARIABLES IN PROGRAM TXCO3:

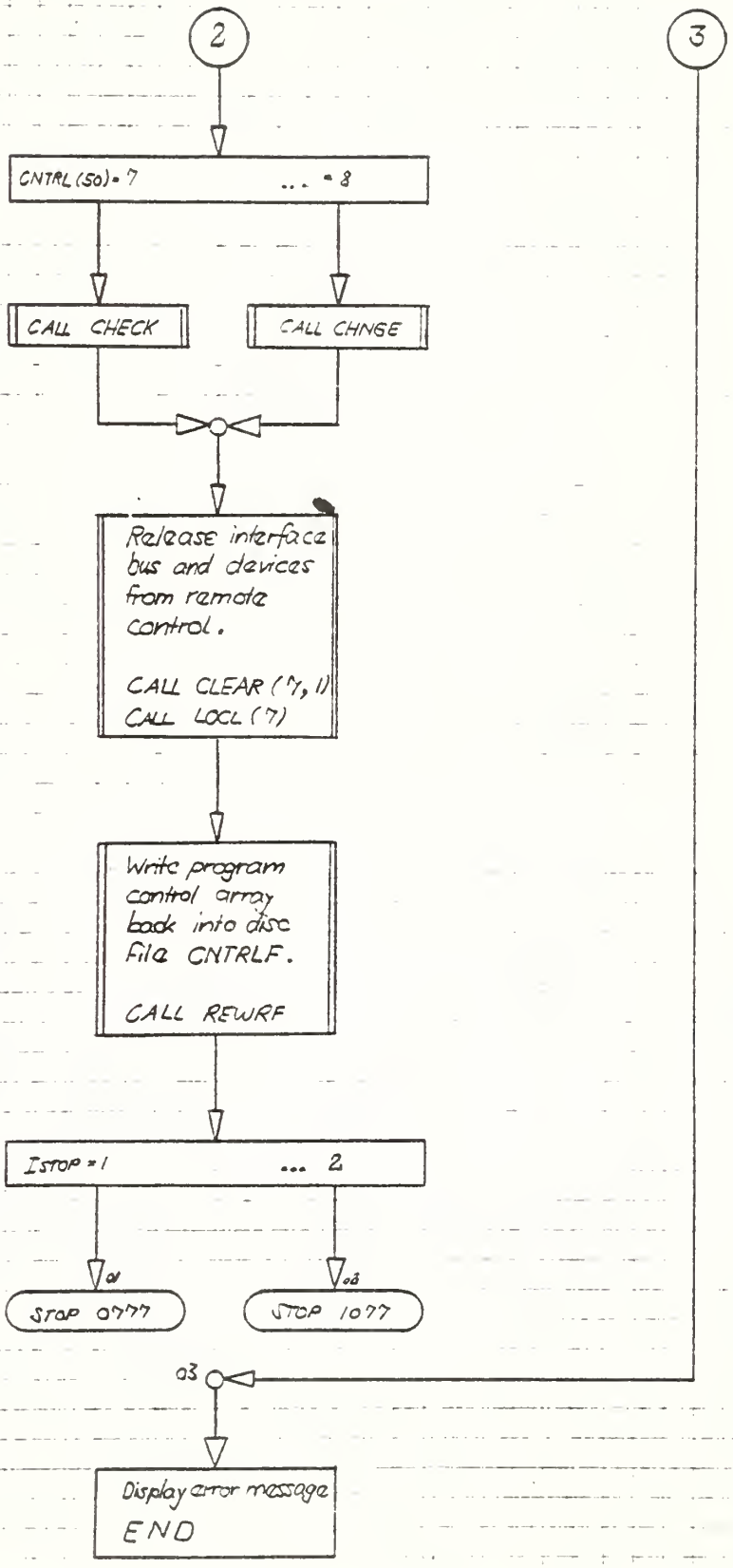
CNTRL (256)	integer	program control array
NOLF	integer	suppresses line feed
LI	integer	LU # of standard input device (terminal)
ISTOP	integer	control variable to select STOP code

FLOW CHART PROGRAM TXC03





*) Lu Assigments:
7 HP Interface Bus
8 Scanner #1
10 Digital Voltmeter
12 Counter
15 Scanner #2


2
3
CNTRL(50) = 7 ... = 8
CALL CHECK
CALL CHNGE
Release interface bus and devices from remote control.
CALL CLEAR ('7, 1)
CALL LOCL (7)
Write program control array back into disc file CNTRLF.
CALL REWRF
ISTOP = 1 ... 2
01
02
STOP 0777
STOP 1077
03
Display error message
END

6.2. SUBROUTINE CHECK:

PURPOSE: This subroutine enables the investigator to (independently from the data acquisition modules ABSRV, CALIB, FREER, PACER, COMB and STDY) check all data locations to troubleshoot or verify the transonic compressor test rig measurement system.

ARGUMENTS: LO ; this variable specifies the output unit where the protocol of the check is directed to. In any case, the data are displayed on the standard input device (terminal LI) and if LO is equal to LI, double output is suppressed. The selection of LO = 6 (line printer) is an appropriate choice for a hardcopy of the check protocol.

EXTERNALS: ACQN, SCANR, RPACE

COMMON BLOCK: CONTR; for detailed explanation refer to the TXCO3 description.

MNEMONIC ABBREVIATIONS: None

ERROR MESSAGES: None

PROCEDURE: For more detailed information, study the flow chart. After having assigned the I/O reference, CHECK asks the operator which particular system should be checked.

Instrumentation code	system being checked
1	S/V-S/V controller - scanner - DVM - system

Instrumentation Code	System Being Checked
2	amplifier - scanner - DVM - system
3	Pacer

The operator then selects the desired code and the program branches.

i) S/V - S/V controller - scanner - DVM - system

The operator has to input the number (1 thru 5) of the S/V, the low port and the high port. Erroneous input will cause the program to re-request the data. If S/V #2 is selected and either low or high port are odd, they will be increased to the next even number. In increments of 1 (2 resp., if S/V #2 is addressed) the subroutine steps from low to high port, taking a reading of each. The result is displayed and printed immediately. Upon completion the operator is asked whether another check shall be done. The answer is YES or NO, and if YES is entered, SUBROUTINE CHECK is run again from the beginning.

ii) amplifier - scanner - DVM - system

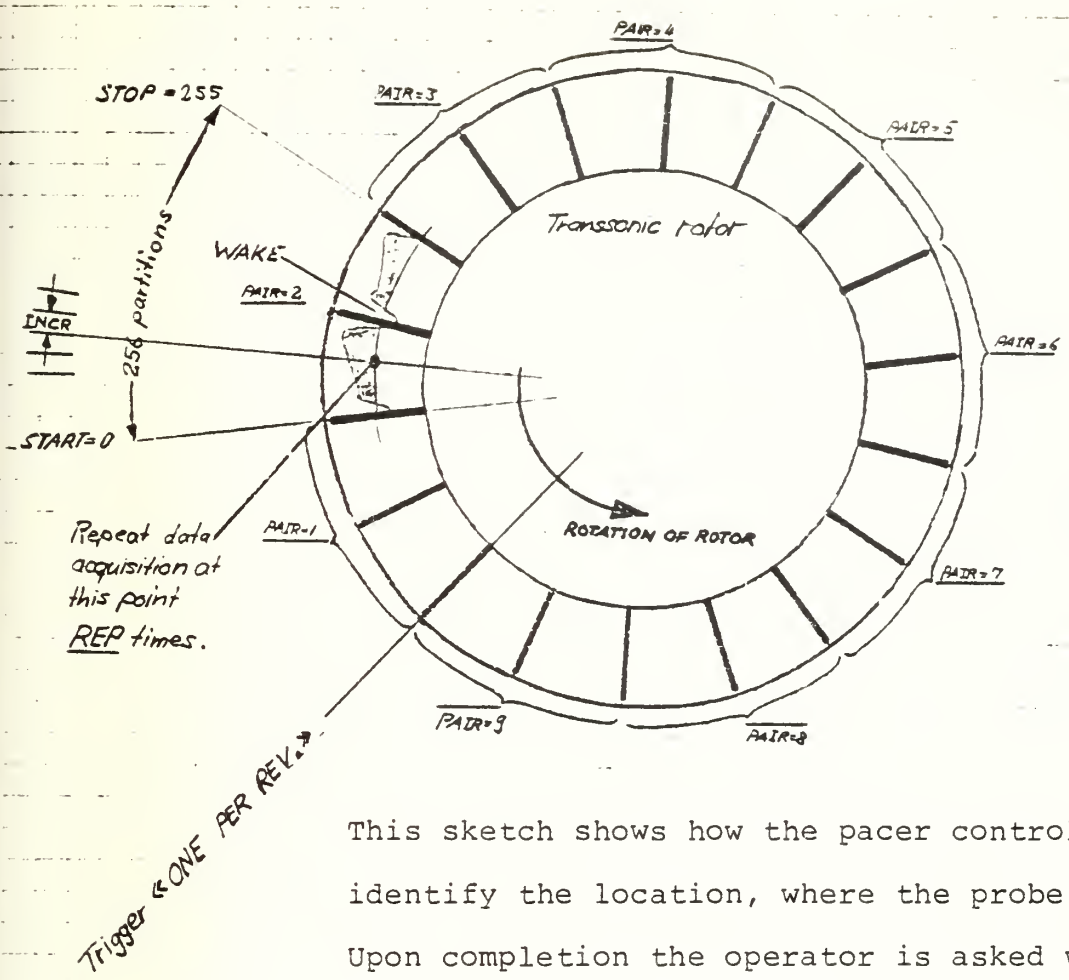
The operator has to input the number (1 or 2) of the scanner, the low channel and the high channel. Erroneous input of the scanner # will cause the program to re-request the data, whereas no check is made whether the boundaries for the scan, low channel ILOW and high channel IHIGH, are correct. In increments of 1 the subroutine steps from low channel to high channel, taking a reading at each port. The result is displayed and printed immediately. Upon completion, the operator is

asked whether another check shall be done. The answer is YES or NO, and if YES is entered, SUBROUTINE CHECK is run again from the beginning.

iii) Pacer

The operator has to input the pacer control parameters:

ADCHNL	A/D analog input channel to be selected by the A/D converter multiplexer.
PAMO	Pacer mode = 1 allows pacer to trigger A/D conversion at the specified position in any blade interval. The variable PAIR is ignored. = 2 causes pacer to select blade pair # PAIR.
PAIR	# of blade pair selected (1 - 9)
START	Start count to step through blade passage
INCR	Increment to step through blade passage
STOP	Stop count to step through blade passage
REP	Number of repetitions at each individual point



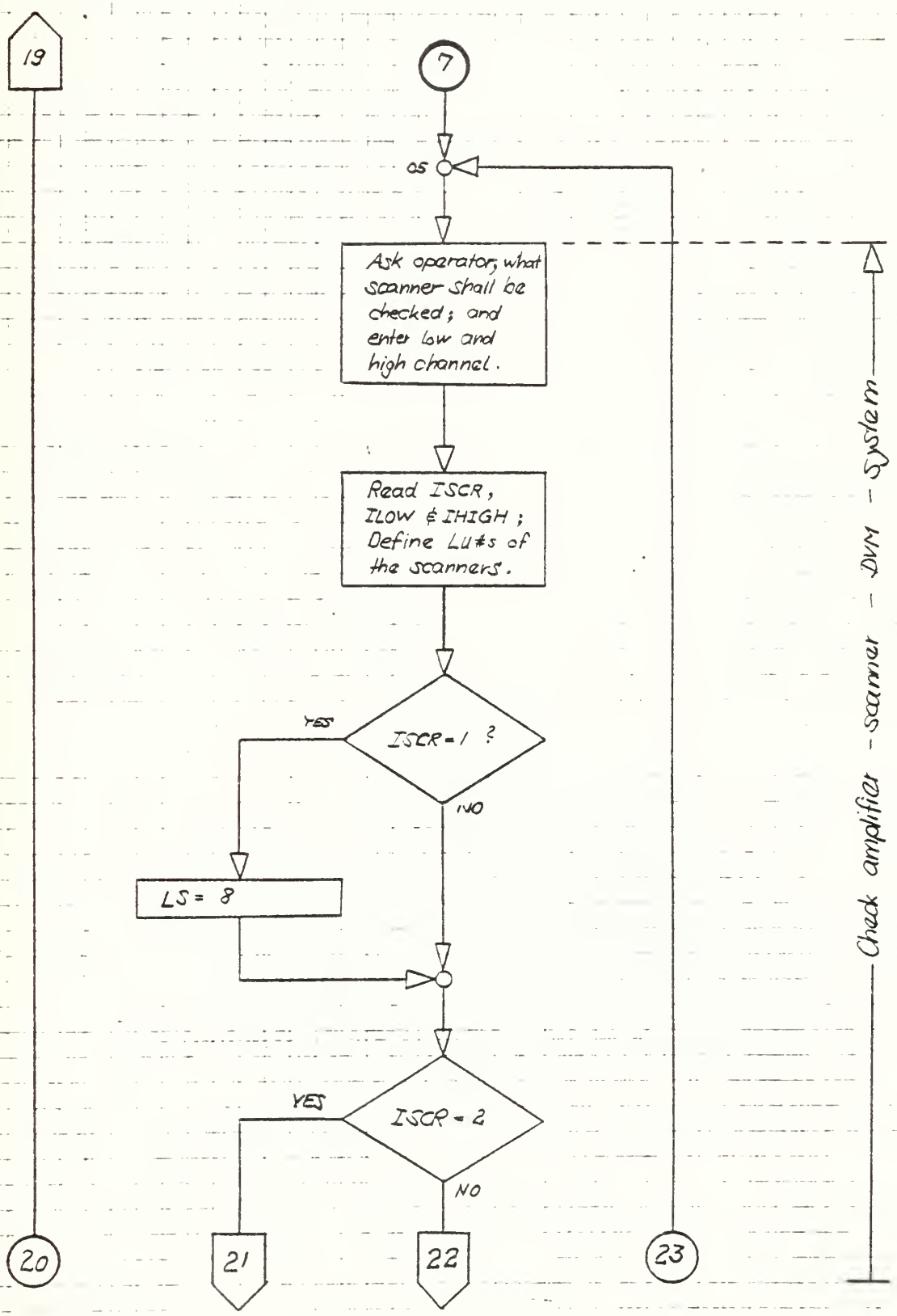
This sketch shows how the pacer control parameters identify the location, where the probe takes data. Upon completion the operator is asked whether another check shall be done. The answer is YES or NO, and if YES is entered, start to read this section SUBROUTINE CHECK again.

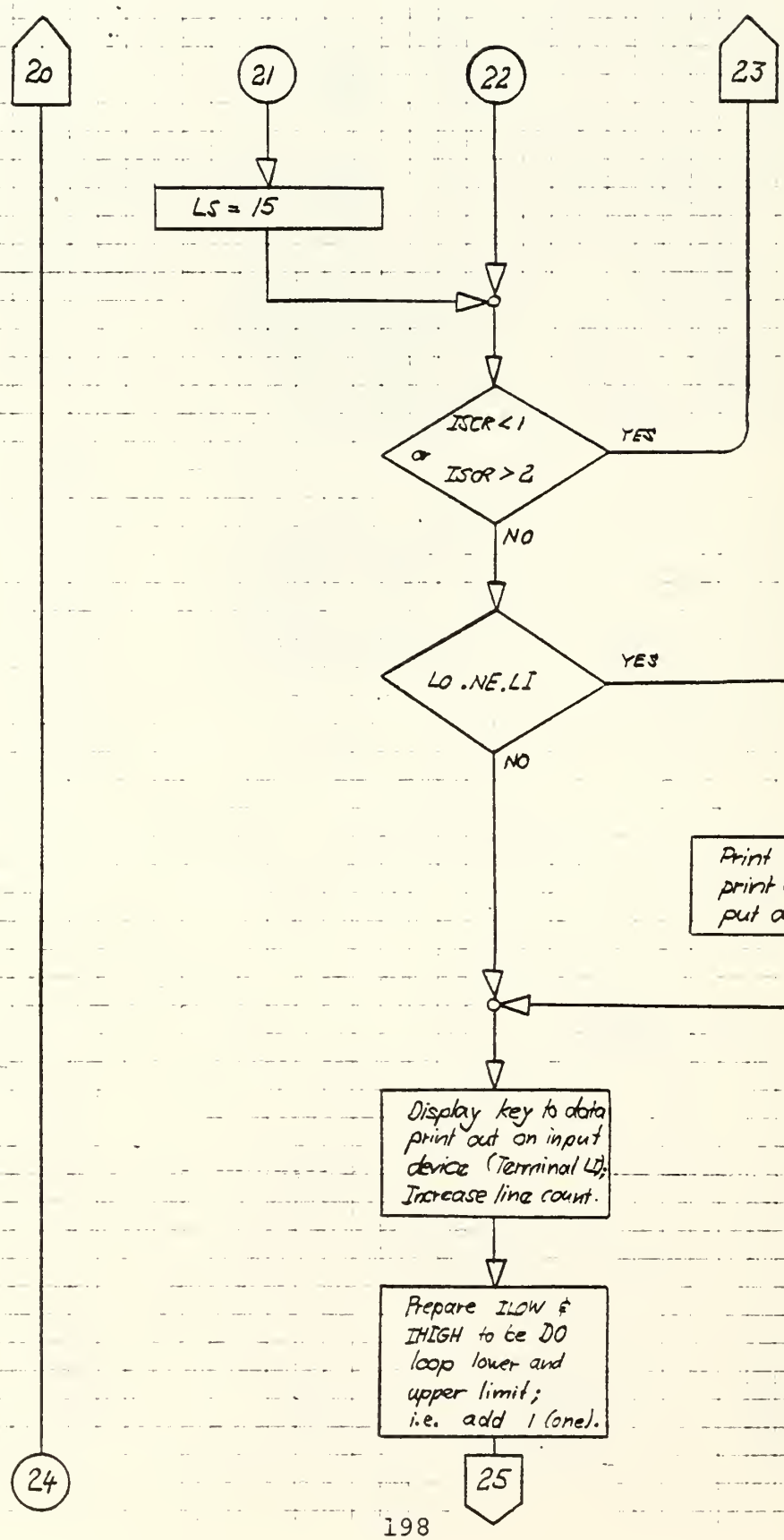
DATA FILE: None

VARIABLES:

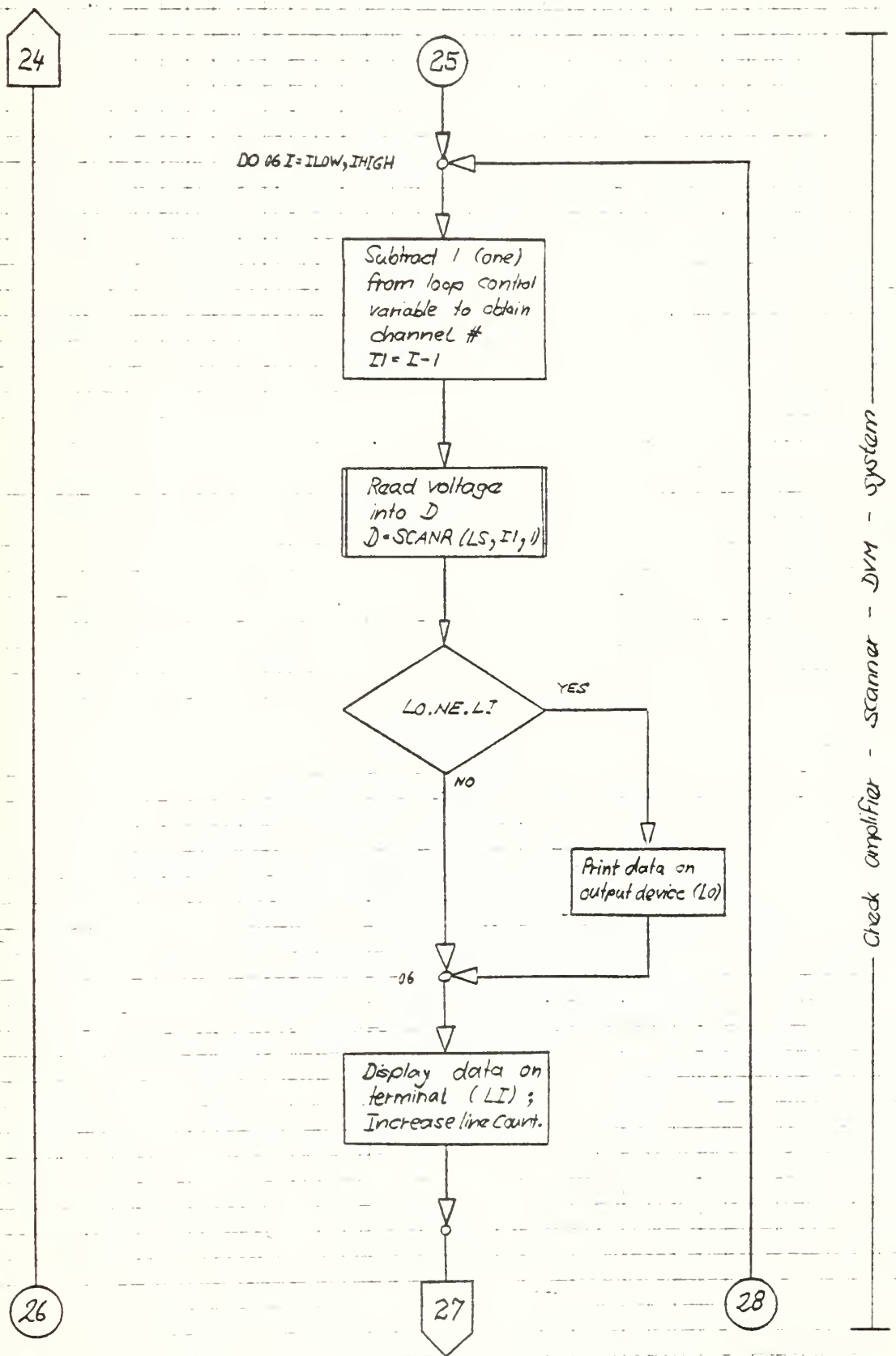
LO	integer	LU# of standard output device (line printer)
CNTRL(256)	integer	program control array
NOLF	integer	suppresses line feed
NOCR(2)	integer	suppresses line feed and carriage return
ICLR(3)	integer	clears line above cursor

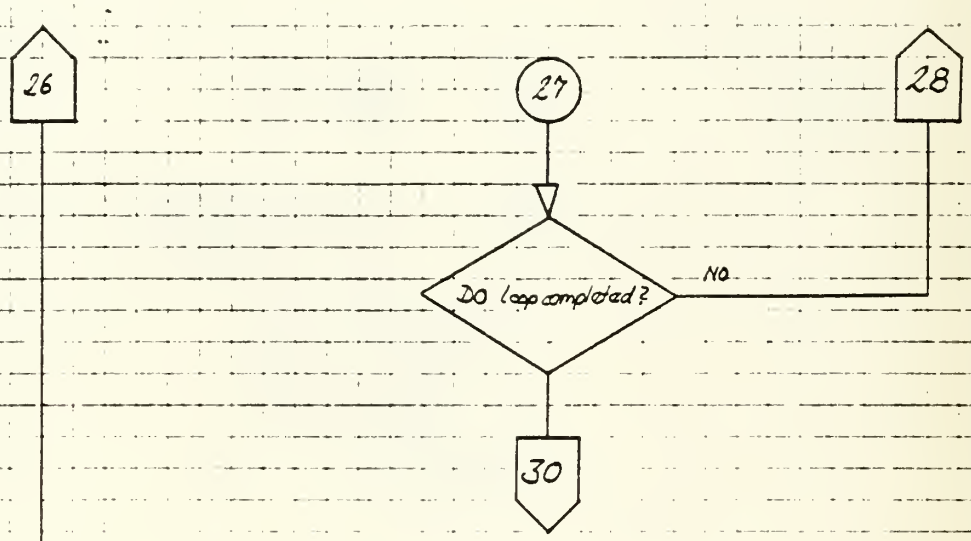
ADCHNL	integer	Pacer control parameter	see sectio
PAMO	integer	Pacer control parameter	iii) for
PAIR	integer	Pacer control parameter	detailed
START	integer	Pacer control parameter	explana-
INCR	integer	Pacer control parameter	tion
STOP	integer	Pacer control parameter	
REP	integer	Pacer control parameter	
LI	integer	LU# of standard interactive input device (system terminal)	
LINES	integer	line count	
IDIUM	integer	decision variable	
IPORT	integer	# of desired S/V (1 — 5)	
ILOW	integer	low port of desired S/V	
IHIGH	integer	high port of desired S/V	
ISTEP	integer	increment to step from low to high port	
IW	integer	delay between closing S/V port and taking the DVM reading in tens of ms.	
V	real	pressure reading (raw data)	
ISCR	integer	# of desired scanner (1 or 2)	
ILOW	integer	low channel of desired scanner	
IHIGH	integer	high channel of desired scanner	
LS	integer	LU# of the desired scanner	
D	real	voltage reading (raw data)	
AVRGE	real	average voltage as returned from subroutine RPACE	


19
7
as
Ask operator, what scanner shall be checked; and enter low and high channel.
Read ISCR, ILOW & IHIGH; Define LU#s of the scanners.
ISCR = 1 ?
YES
NO
LS = 8
ISCR = 2
YES
NO
20
21
22
23
Check amplifier - scanner - DVM - System

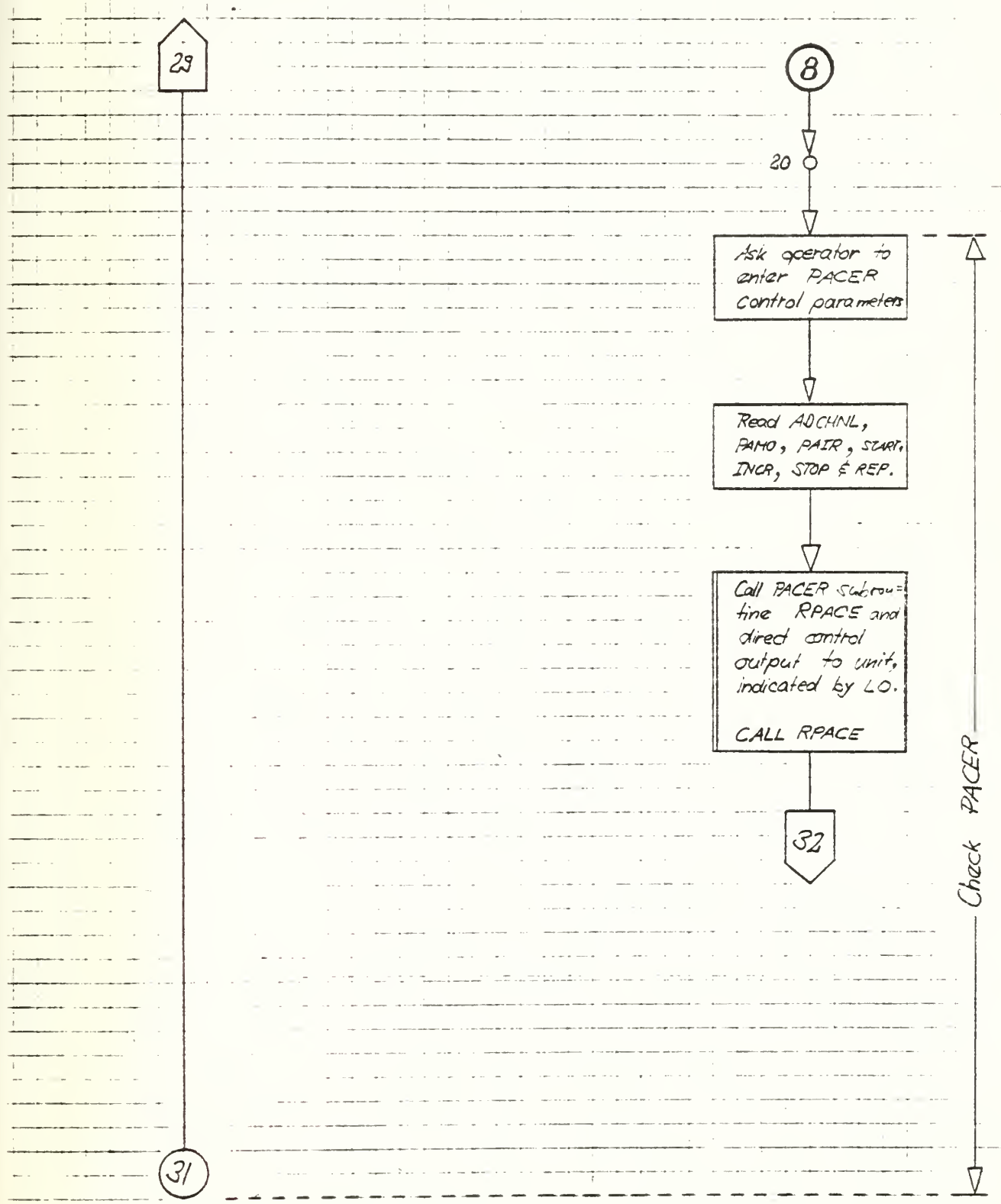


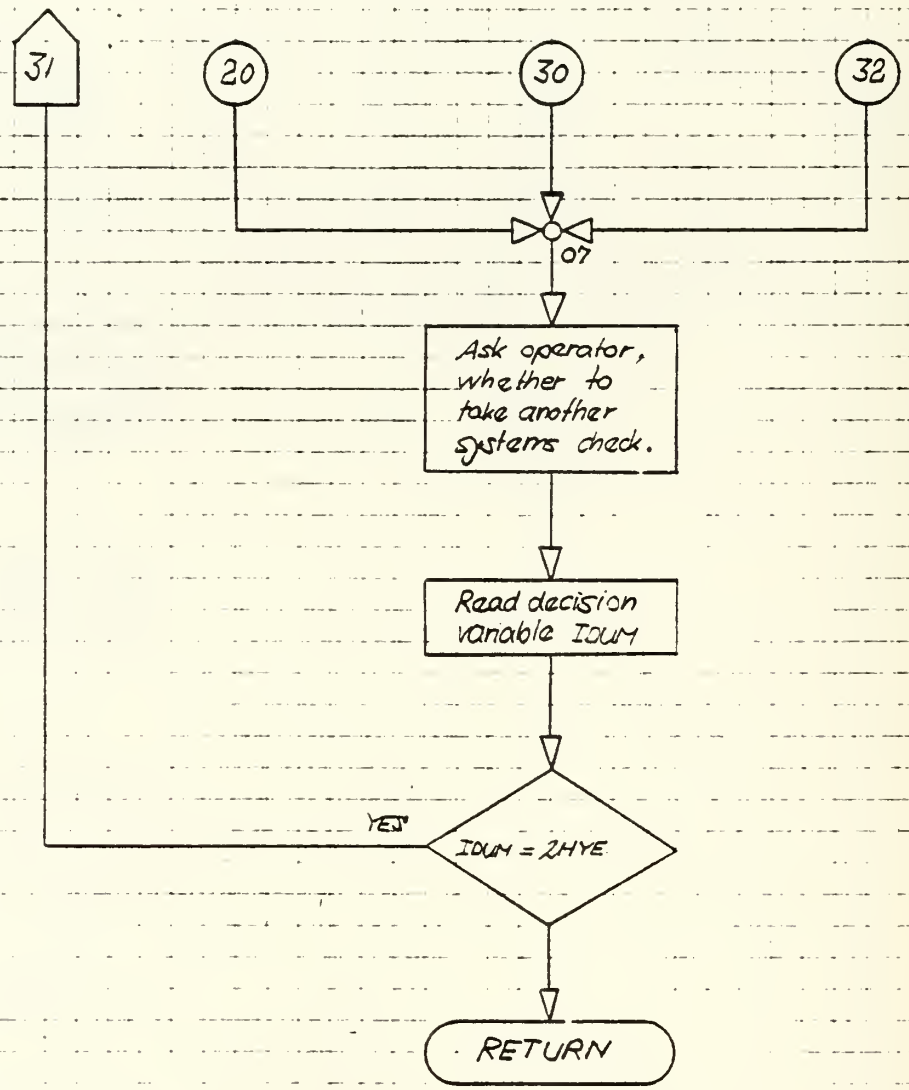
Check amplifier - Scanner - DVM - System

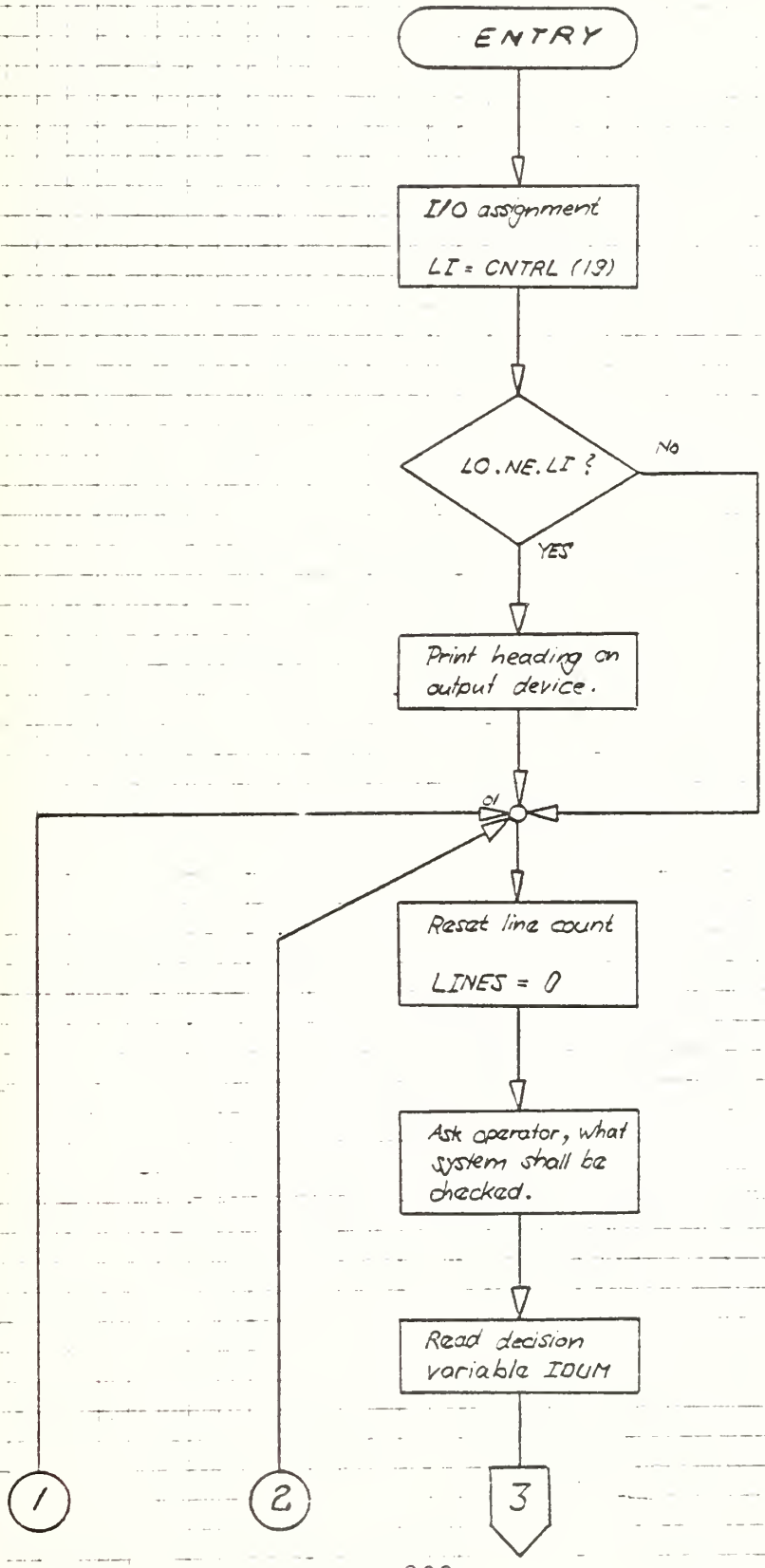

24
25
DO 06 I=ILOW,IHIGH
Subtract 1 (one) from loop control variable to obtain channel #
II = I-1
Read voltage into D
D=SCANR (LS, II, 1)
LO.NE.L?
YES
NO
Print data on output device (LO)
06
Display data on terminal (LI); Increase line count.
26
27
28
Check amplifier - scanner - DVM - system

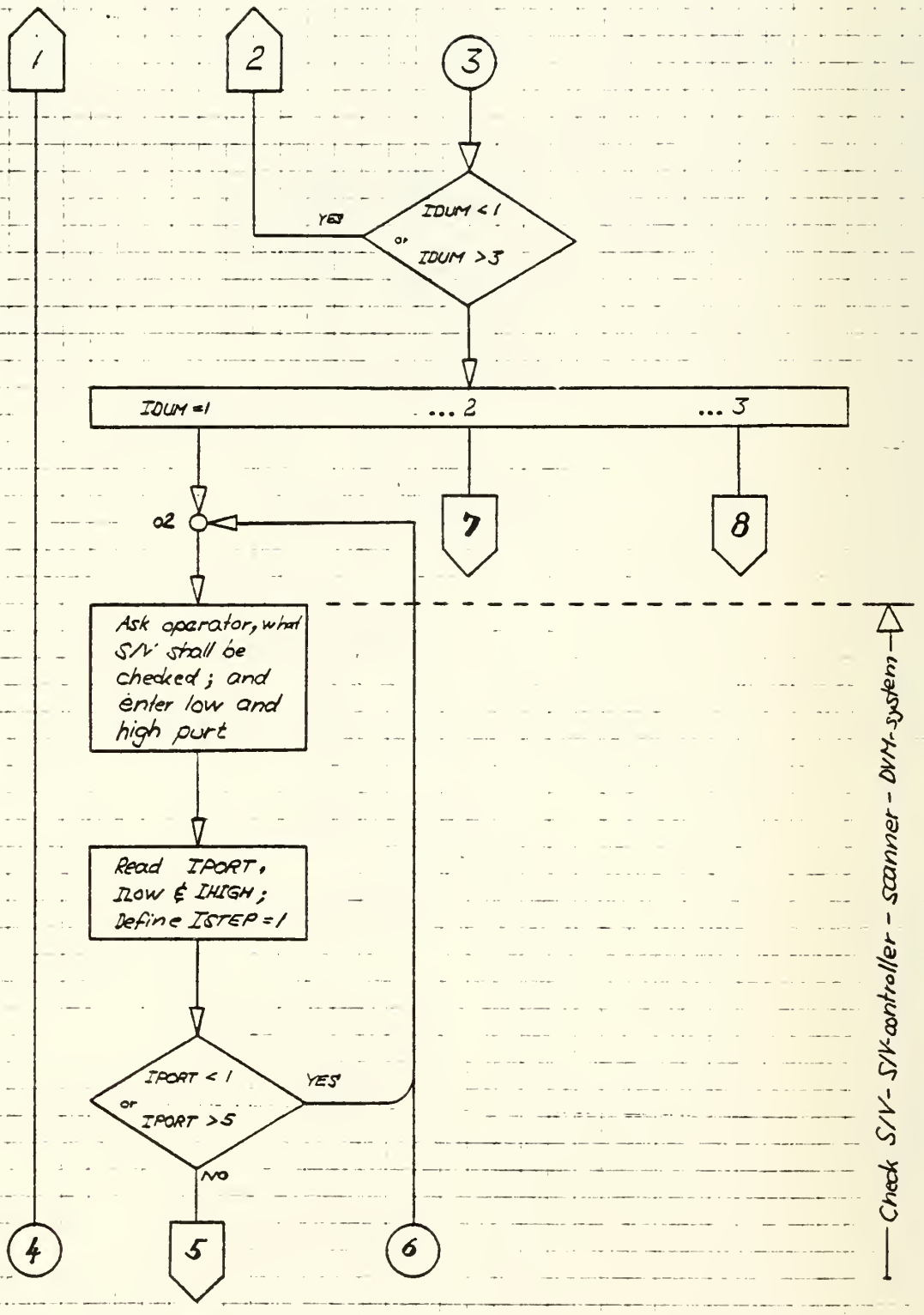


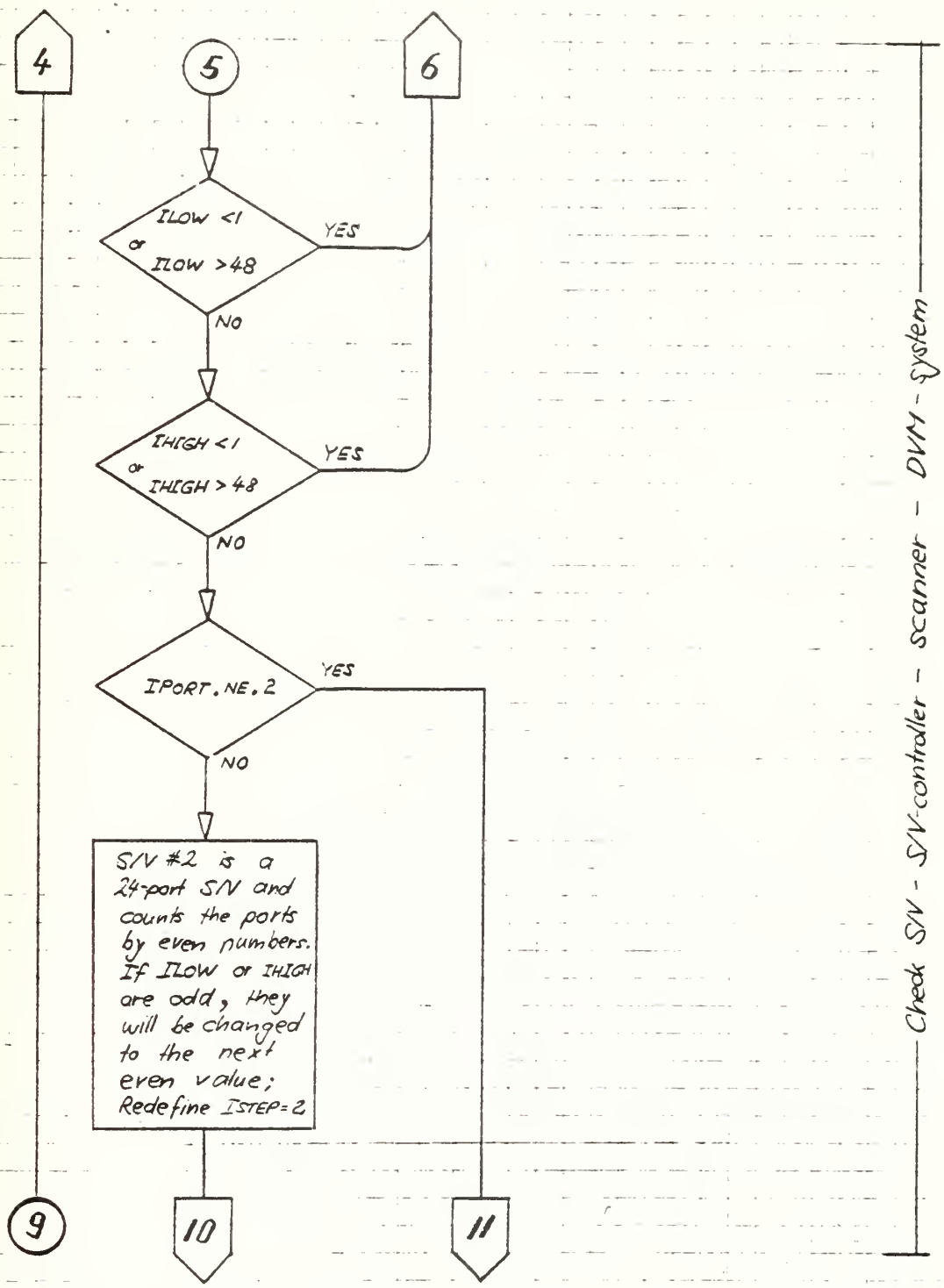
Check amplifier - scanner - DMY - system

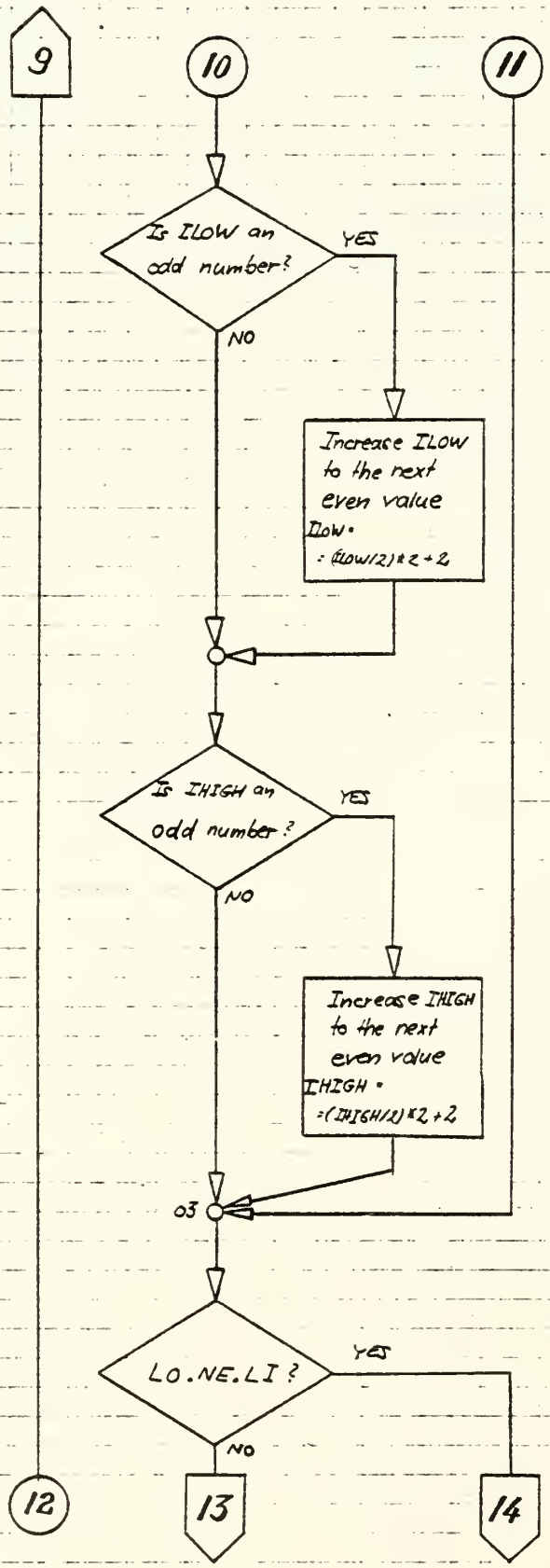

29
8
20
Ask operator to enter PACER control parameters
Read ADCHNL, PAMO, PAIR, START, INCR, STOP & REP.
Call PACER subroutine RPACE and direct control output to unit, indicated by LO.
CALL RPACE
32
Check PACER
31


31
20
30
32
07
Ask operator, whether to take another systems check.
Read decision variable IOUM
"YES"
IOUM = 2HYE
RETURN

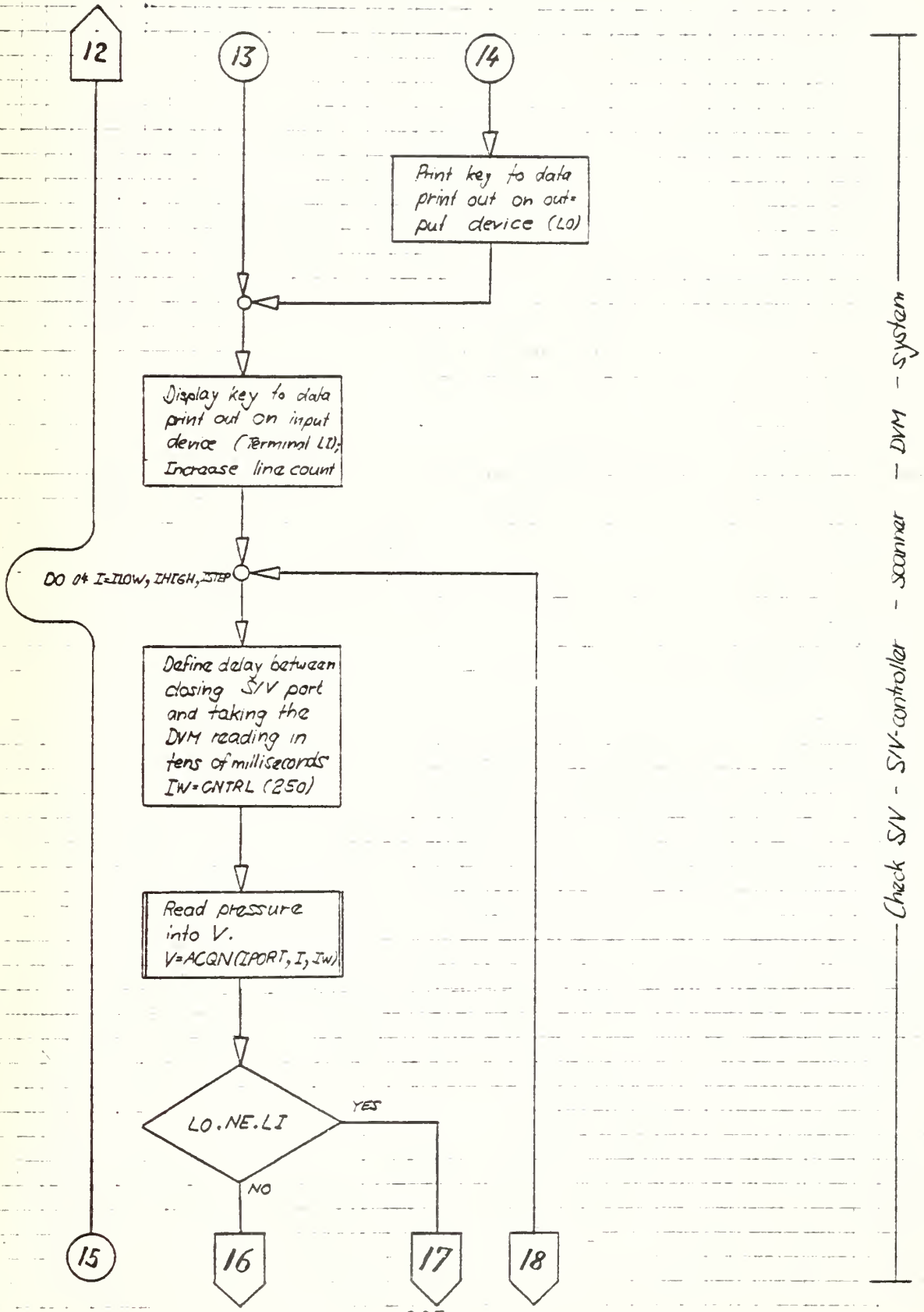

ENTRY
I/O assignment
LI = CNTRL (19)
LO.NE.LI ?
NO
YES
Print heading on output device.
OI
Reset line count
LINES = 0
Ask operator, what system shall be checked.
Read decision variable IOUM
1
2
3

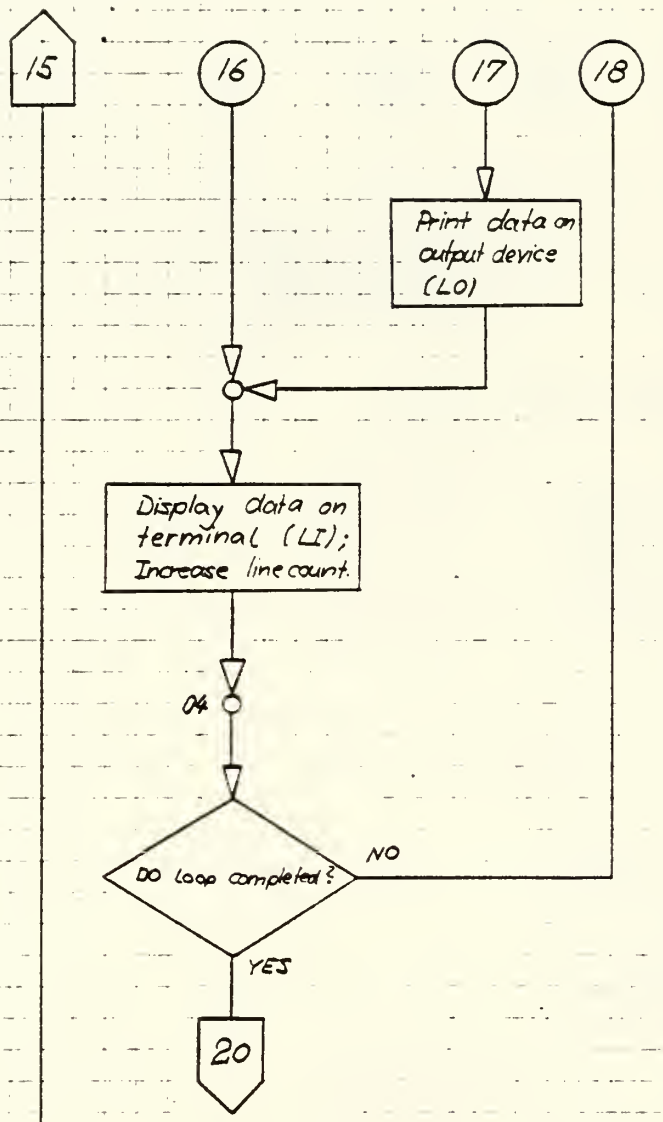

1
2
3
IDUM < 1
or
IDUM > 3
YES
IDUM = 1
... 2
... 3
o2
7
8
Ask operator, what S/V shall be checked; and enter low and high port
Read IPORT, ILOW & IHIGH; Define ISTEP = 1
IPORT < 1
or
IPORT > 5
YES
NO
4
5
6
Check S/V - S/V-controller - scanner - DVH-system


4
5
6
ILOW <1
or
ILOW >48
YES
NO
IHIGH <1
or
IHIGH > 48
YES
NO
IPORT.NE.2
YES
NO
S/V #2 is a 24-port S/V and counts the ports by even numbers. If ILOW or IHIGH are odd, they will be changed to the next even value; Redefine ISTEP=2
9
10
11
Check S/V - S/V-controller - scanner - DVM - system



Check S/V - S/V-controller - scanner - O/H - system


12
13
14
Print key to data print out on output device (LO)
Display key to data print out on input device (Terminal LI); Increase line count
DO 04 I=ILOW, IHIGH, ISTEP
Define delay between closing S/V port and taking the DVM reading in tens of milliseconds IW=CNTRL (250)
Read pressure into V. V=ACQN(IPORT, I, IW)
LO.NE.LI
YES
NO
15
16
17
18
Check S/V - S/V-controller - scanner - DVM - system



Check S/N - S/N-controller - scanner - DVM - system

6.3. SUBROUTINE CHNGE:

PURPOSE: Change any element of the program control array CNTRL on line and display any element of CNTRL.

ARGUMENTS: None

EXTERNALS: CODE, REWRF

COMMON BLOCK: CONTR; for detailed explanation refer to the TXCO3 description.

MNEMONIC ABBREVIATIONS:

C ... Change CNTRL (i) to new value

D ... Display current value of CNTRL (i)

R ... Return to the calling program

Note: C is followed by the value of ≪i≫ and the new value for ≪CNTRL (i)≫ and D is followed by the value of ≪i≫.

ERROR MESSAGES: None

PROCEDURE: For more detailed information, study the flow chart. After having assigned the I/O reference and reset the line count, the operator is asked what to do. The input in the first inverse video box specifies where to branch to.

i) Change CNTRL (i) to new value Input: C

The control character C is followed by the value of ≪i≫ and the new value for ≪CNTRL (i)≫. Each of the latter data items has to be aligned to the right margin of the two

following inverse video boxes. If the input is to be compiled as ASCII code, the identifier 2H has to precede the two input characters.

EXAMPLE A) Suppose, the time delay IW between closing a S/V port and taking the DVM reading shall be changed to 1 second, which is 100*10 milliseconds. Enter

C	250	100

and press the RETURN key. The subroutine responds displaying the message CNTRL (250) changed from 80 to 100. Where 80 is the previous value of CNTRL (250).

EXAMPLE B) The character, used to display the just acquired wave form in subroutine PACER shall be changed to the asterisk (= 2H*␣). Enter

C	249	2H*␣

blank, because subroutine PICTR outputs this item in A1-Format

and press the RETURN key. The subroutine responds displaying

CNTRL (249) changed from 2H+␣ to 2H*␣ .

where the add sign (= 2H+␣) was previously used for the plot.

ii) Display actual value of CNTRL (i) [Input: D]

The control character C is followed by the value of ≪i≫ and, only if the element CNTRL (i) shall be displayed in ASCII-mode, the string ≪2H≫ . The data for ≪i≫ has to be aligned to right margin of the second inverse video box and ≪2H≫ has to be centered in the third box.

EXAMPLE A) Display the value for the cartridge reference number, where the raw data files are located. Appendix A.3 (Program Control Array) reveals that you have to look into CNTRL(30). Enter

[D] [30] [ ]

and press the RETURN key. The subroutine responds by informing you that

The actual value of CNTRL (30) is 26.

EXAMPLE B) Display the first two characters of the name of the raw data file, which are written into CNTRL (32). Since the file name is ASCII coded, the ASCII-identifier ≪2H≫ must not be forgotten. Enter

[D] [32] [2H]

and press the [RETURN] key. The subroutine responds by informing you, that

The actual value of CNTRL (32) is 2HT5.

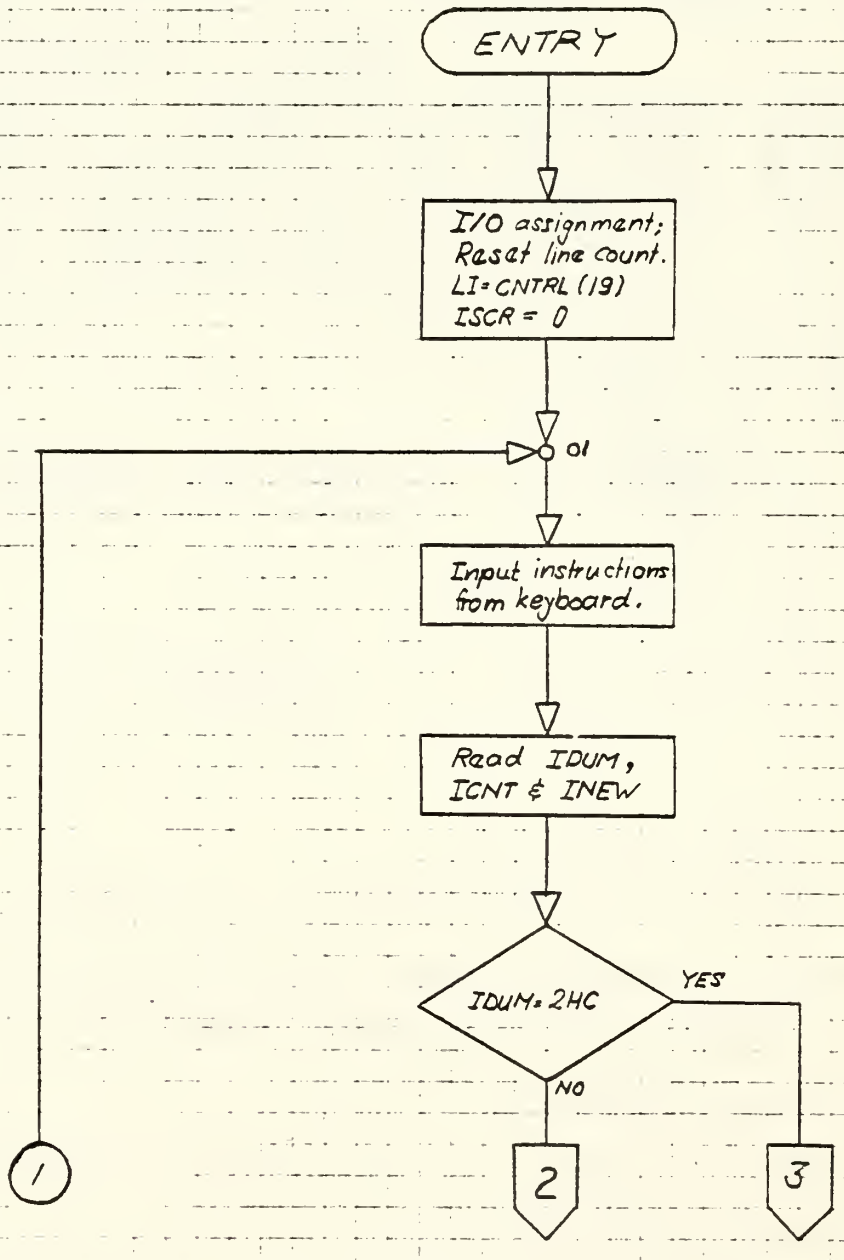
This information reveals that the last data acquisition was a combination probe survey, since there all data file names start with ≪T5≫ .

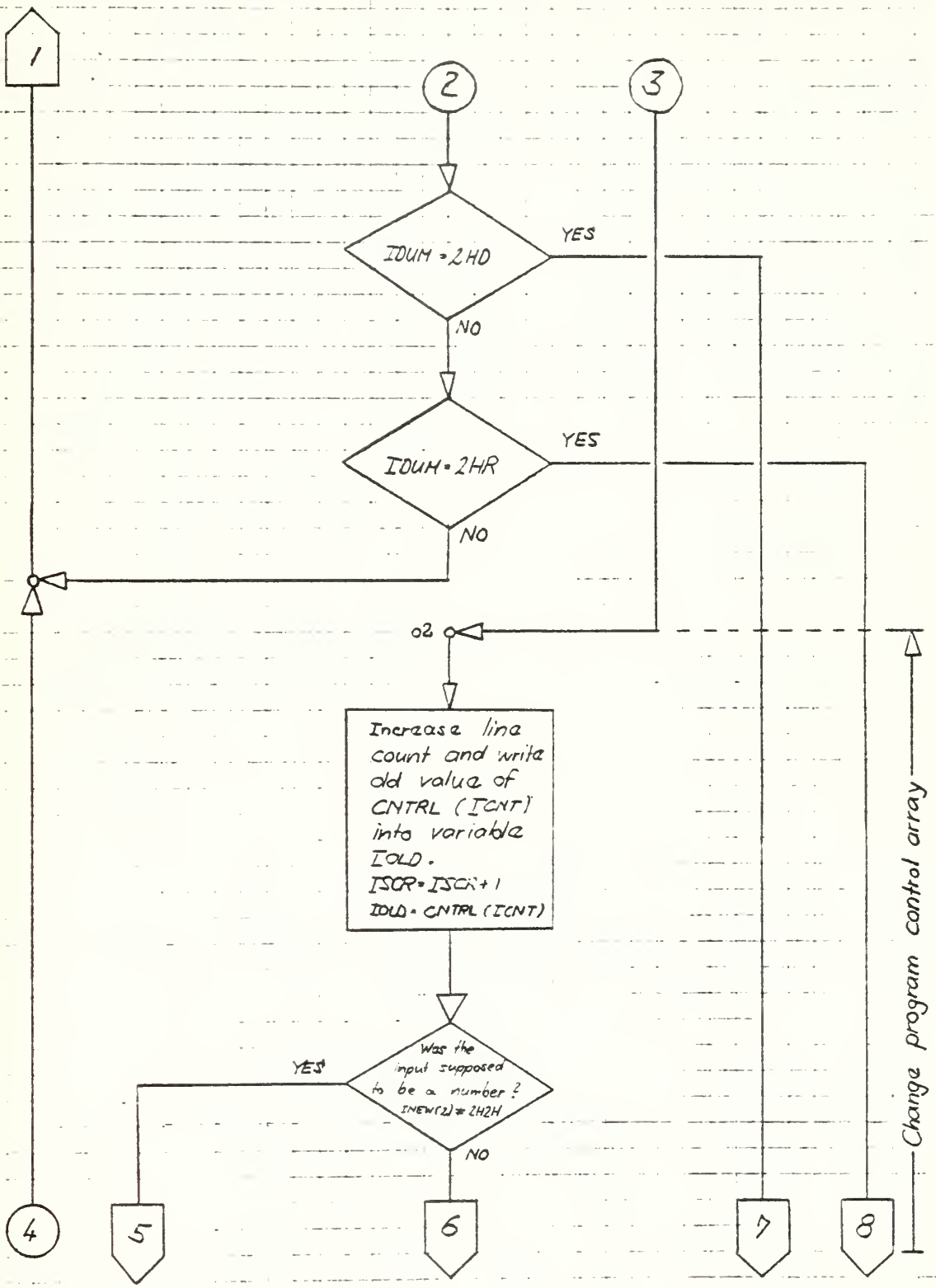
iii) Return [Input: R]

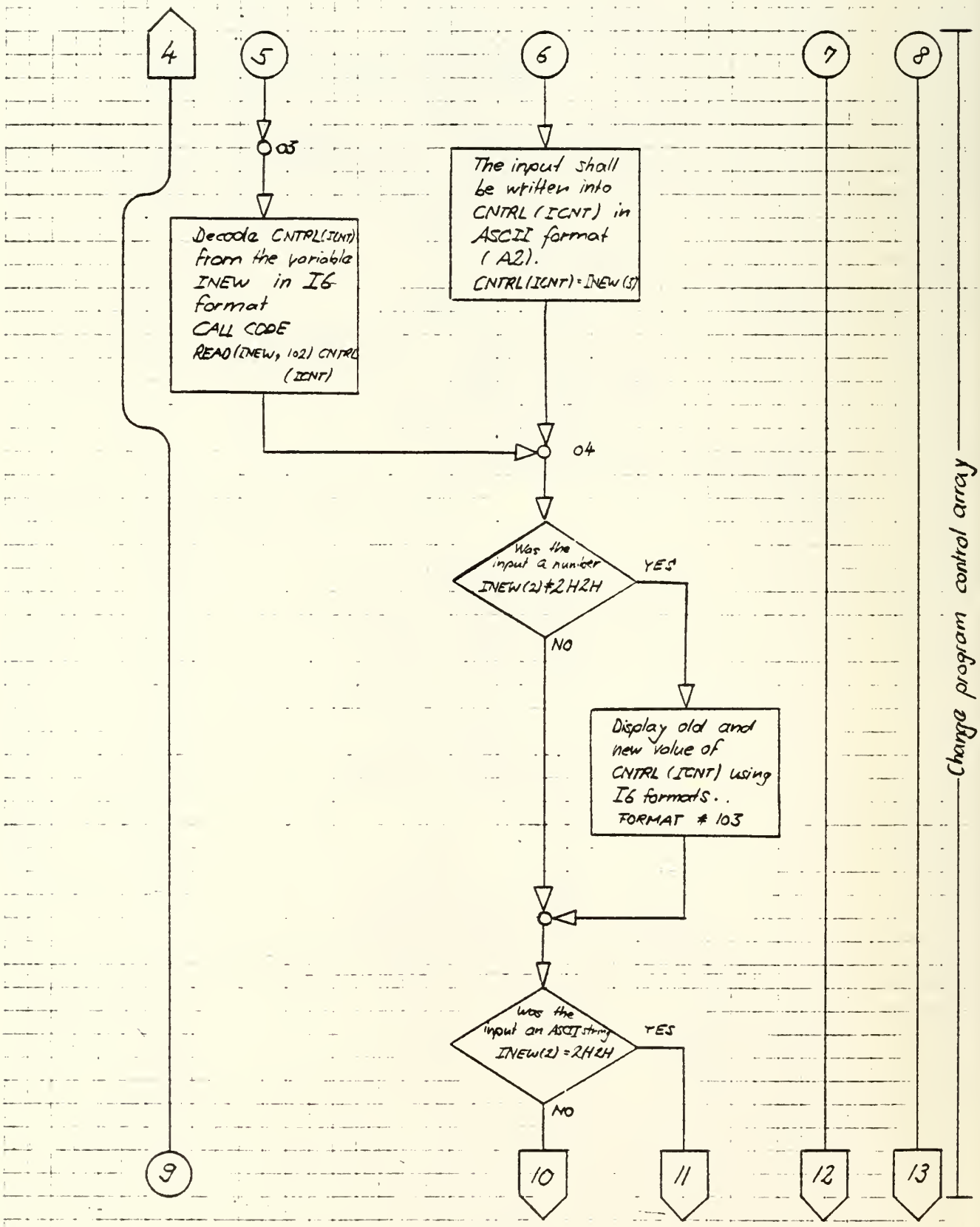
Enter R: Now the subroutine asks, whether to clear the informative responses, displayed by this subroutine previously. Inputting anything else but NO initializes the program to clear the screen.

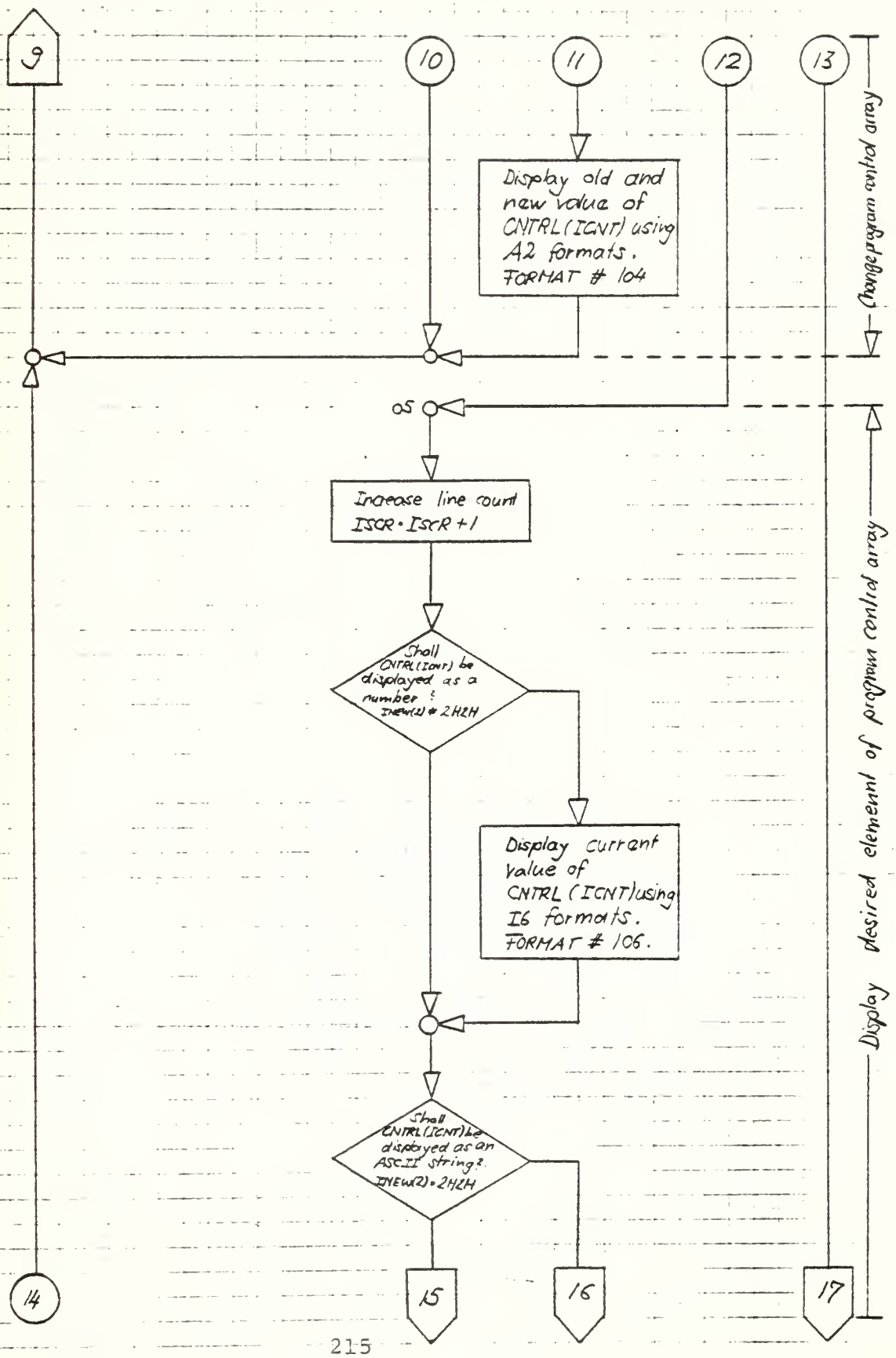
Then the subroutine terminates writing the modified control array back into disc file.

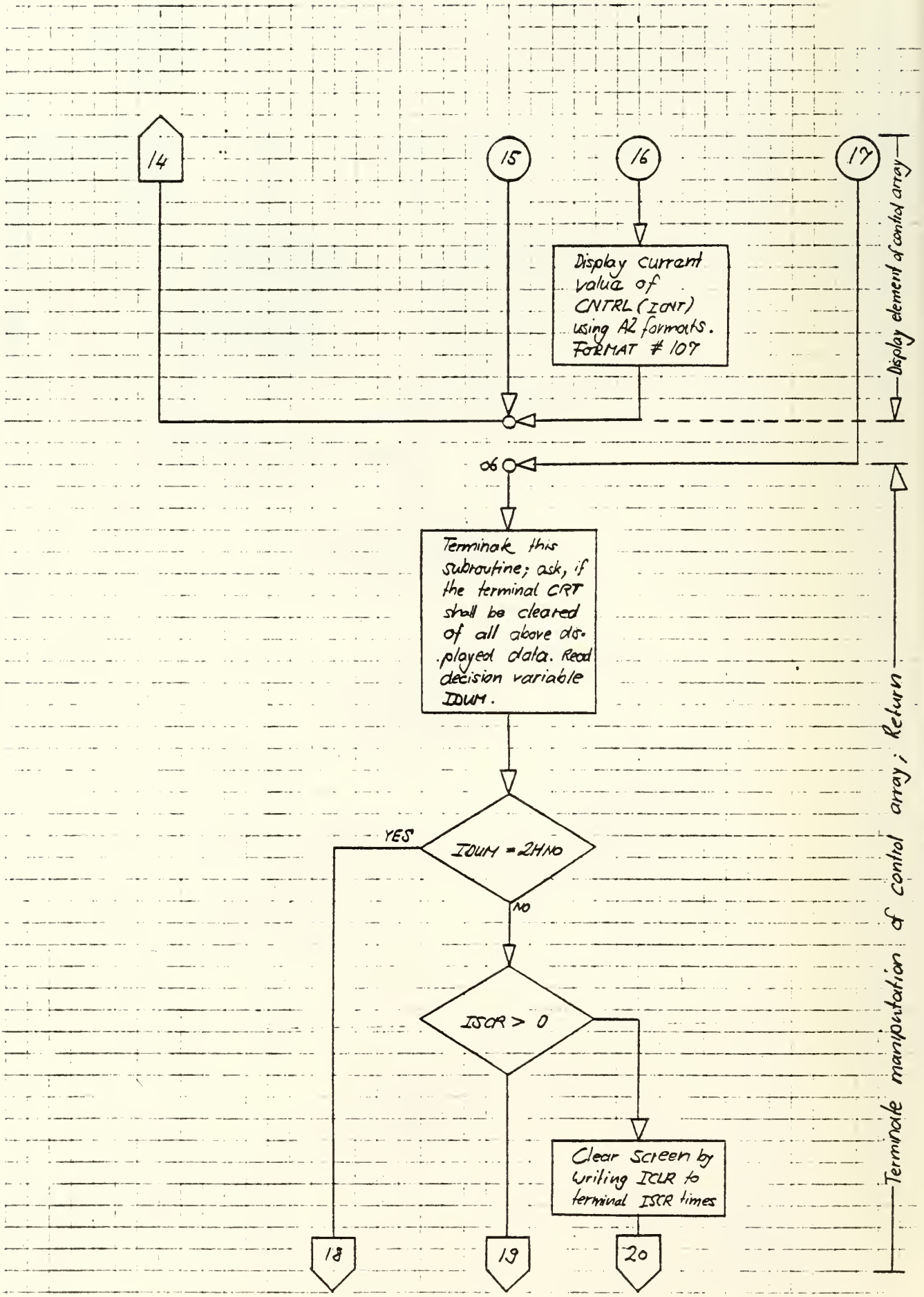
FLOW CHART SUBROUTINE CHNGE

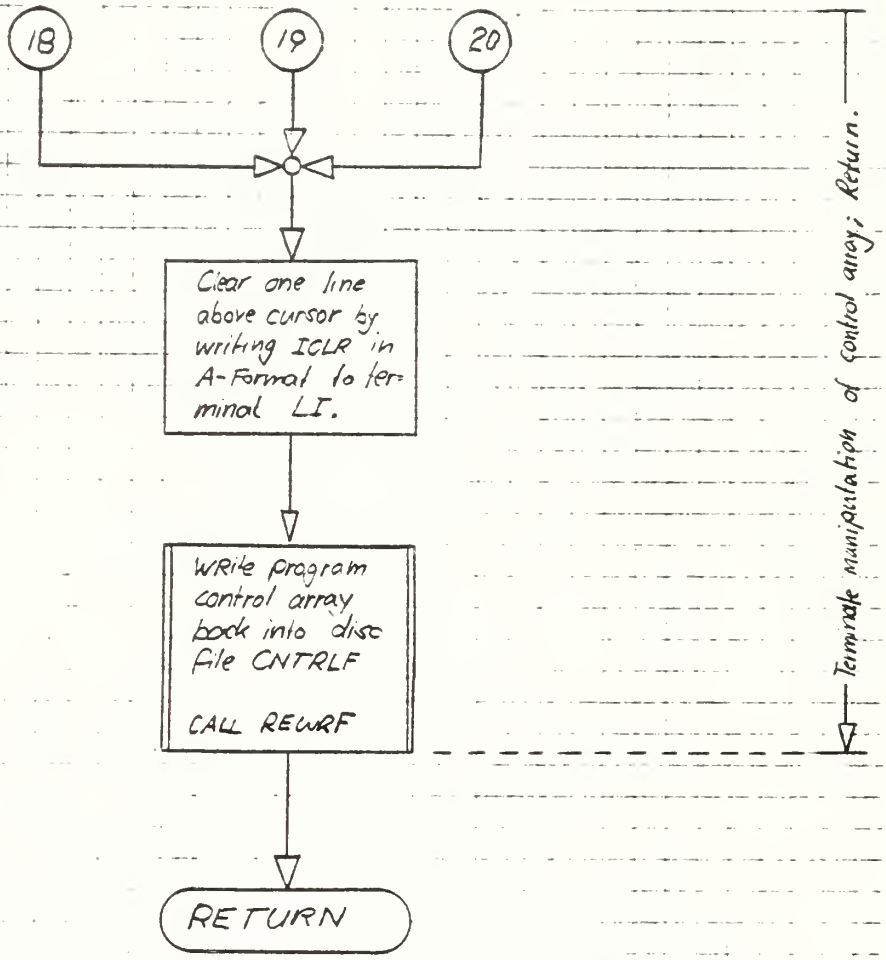



1
2
3
IDUM = 2H0
YES
NO
IDUM = 2HR
YES
NO
o2
Increase line count and write old value of CNTRL (ICNT) into variable IOLD.
ISCR = ISCR + 1
IOLD = CNTRL (ICNT)
Was the input supposed to be a number ? INEW(I) ≠ 2H2H
YES
NO
4
5
6
7
8
Change program control array


4
5
6
7
8
05
Decode CNTRL(ICNT) from the variable INEW in I6 format
CALL CODE
READ(INEW, 102) CNTRL (ICNT)
The input shall be written into CNTRL(ICNT) in ASCII format (A2).
CNTRL(ICNT) = INEW(1)
04
Was the input a number INEW(2) ≠ 2H2H
YES
NO
Display old and new value of CNTRL(ICNT) using I6 formats..
FORMAT # 103
Was the input an ASCII string INEW(2) = 2H2H
YES
NO
9
10
11
12
13
Change program control array


9
10
11
12
13
Display old and new value of CNTRL(ICNT) using A2 formats. FORMAT # 104
Change program control array
05
Increase line count ISCR = ISCR + 1
Shall CNTRL(ICNT) be displayed as a number? INEW(2) = 2H2H
Display current value of CNTRL(ICNT) using I6 formats. FORMAT # 106.
Shall CNTRL(ICNT) be displayed as an ASCII string? INEW(2) = 2H1H
Display desired element of program control array
14
15
16
17


14
15
16
17
Display current value of CNTRL(ICNT) using A2 formats. FORMAT # 107
Display element of contol array
06
Terminate this subroutine; ask, if the terminal CRT shall be cleared of all above displayed data. Read decision variable IDUM.
IDUM = 2HNO
YES
NO
ISCR > 0
Clear Screen by writing ICLR to terminal ISCR times
18
19
20
Terminate manipulation of contol array; Return


18
19
20
Clear one line above cursor by writing ICLR in A-Format to terminal LI.
WRite program control array back into disc file CNTRLF
CALL REWRF
RETURN
Terminate manipulation of control array; Return.

6.4. PROGRAM LISTING TXCO3

```
PAGE 0001  FTN.    4:12 PM  TUE., 23  SEP., 1980

0001  FTN4,L
0002          BLOCK DATA
0003         *, / FMP    / IDCB(144),IFILE(3),ISIZE(2),ISECU,ICR
0004          COMMON / FMP    / IDCB,IFILE,ISIZE,ISECU,ICR
0005          INTEGER IDCB(144),IFILE(3),ISIZE(2)
0006          END

  FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)
  **  NO WARNINGS **  NO ERRORS **
BLOCK COMMON FMP     SIZE =  00151
```

```
 PAGE 0002  FTN.   4:12 PM  TUE., 23  SEP., 1980

0007          BLOCK DATA
0008         *, / CIBUF / IFUF(1664)
0009          COMMON / CIBUF / IBUF
0010          INTEGER IBUF(1664)
0011          END

  FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)
  **  NO WARNINGS **  NO ERRORS **
 BLOCK COMMON CIBUF   SIZE =  01664
```

```
 PAGE 0003  FTN.   4:12 PM  TUE., 23  SEP., 1980

0012          BLOCK DATA
0013         *, / CONTR / CNTRL(256)

0014          COMMON / CONTR / CNTRL
0015          INTEGER CNTRL(256)
0016          END

  FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)
  **  NO WARNINGS **  NO ERRORS **
 BLOCK COMMON CONTR  SIZE =  00256
```

```
0017          PROGRAM TXCO3 (3,99)
0018    C     .....................................................................
0019    C     .                                                                   .
0020    C     .  The operating system RTE IV B requests the data acquisition      .
0021    C     .  program TXCO for the one stage transsonic compressor to be       .
0022    C     .  split into several programs scheduled by the father program      .
0023    C     .  TXCO.  This son program TXCO3 consists of the subroutines        .
0024    C     .  CHECK and CHNGE.  These codes handle the equipment check and     .
0025    C     .  the on line modification of the control array.  The data         .
0026    C     .  transfer between father and son programs take place via the      .
0027    C     .  control array CNTRL (disc file CNTRLF) and the data array        .
0028    C     .  IBUF (disc file IBUFF).                                          .
0029    C     .                                                                   .
0030    C     .  The utility subroutines ACQN, CNTL, CURVE, ICON, IPORT,          .
0031    C     .  PICTR, REWRF, RPACE, SCANR, TIME and WAIT are added.             .
0032    C     .                                                                   .
0033    C     .  Author:    Hans M. Zebner                                        .
0034    C     .  Date  :    March 12, 1980                                        .
0035    C     .                                                                   .
0036    C     .  A detailed program description is available in the TXCO log.     .
0037    C     .                                                                   .
0038    C     .....................................................................
0039         *, Third son program of father program TXCO.

0040
0041          COMMON / CONTR / CNTRL
0042
0043          INTEGER CNTRL(256)
0044
0045
0046          DATA NOLF /006537B/
0047
0048      101 FORMAT (9X""20X""A2)
0049      102 FORMAT ("  IXCO3 : PROGRAM ABORTED!  NO SUBROUTINE HAS BE
0050         *EN INITIALIZED.")
0051      801 FORMAT ("CA")
0052     1001 FORMAT ("F1R7M3A1H0T3")
0053     1201 FORMAT ("PF4G6T")
0054     1501 FORMAT ("CA")
0055
0056          CALL REWRF (-1,2)
0057          LI = CNTRL(19)
0058          IF ( CNTRL(50)  .LT.  7   .OR.   CNTRL(50)  .GT.  8 ) GO TO 03
0059
0060    C     .....................................................................
0061    C     .                                                                   .
0062    C     .  Set interface bus and devices to remote control.                 .
0063    C     .                                                                   .
0064    C     .....................................................................
0065          CALL ABRT (7,2)
0066          CALL RMOTE ( 8)
0067          CALL RMOTE (10)
0068          CALL RMOTE (12)
0069          CALL RMOTE (15)
0070          WRITE ( 8, 801)
0071          WRITE (10,1001)
0072          WRITE (12,1201)
0073          WRITE (15,1501)
0074
0075    C     .....................................................................
0076    C     .                                                                   .
0077    C     .  Call subroutine indicated by CNTRL(50).                          .
0078    C     .                                                                   .
0079    C     .....................................................................
0080          ISTOP = CNTRL(50) - 6
0081          IF ( CNTRL(50)  .EQ.  7 ) CALL CHECK(CNTRL(51))
0082          IF ( CNTRL(50)  .EQ.  8 ) CALL CHNGE
0083
0084    C     .....................................................................
0085    C     .                                                                   .
0086    C     .  Release interface bus and devices from remote control.           .
0087    C     .                                                                   .
0088    C     .....................................................................
0089          CALL CLEAR (7,1)
0090          CALL LOCL (7)
0091
```

```
 PAGE 0005  TXC03  4:12 PM  TUE., 23  SEP., 1980

0092          CALL REWRF (1,2)
0093          WRITE (LI, 101) NOLF
0094          GO TO (01,02) ISTOP
0095       01 STOP 0777
0096       02 STOP 1077
0097       03 WRITE (LI, 102)
0098          END


  FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

  **  NO WARNINGS **  NO ERRORS **   PROGRAM = 00220      COMMON = 00000
```

```
0099          SUBROUTINE CHECK (LO)
0100    C     .....................................................................
0101    C     .                                                                   .
0102    C     .  Instrumentation check.                                           .
0103    C     .  Author:    Hans M. Zebner                                        .
0104    C     .  Date  :    January 11, 1980                                      .
0105    C     .  Detailed program description is available in TXCO log;  The      .
0106    C     .  Comment statements match to the flow chart explanations.         .
0107    C     .                                                                   .
0108    C     .....................................................................
0109         *, Checks the instrumentation.
0110
0111          COMMON / CONTR / CNTRL
0112
0113          INTEGER CNTRL(256),NOLF,NOCR(2),ICLR(3)
0114          INTEGER ADCHNL,PAMO,PAIR,START,INCR,STOP,REP
0115
0116    C     FORMATS CHECK START
0117      100 FORMAT ("1SUBROUTINE CHECK; CONTROL OUT
0118         *  ")
0119      101 FORMAT (/"Enter instrumentation code"//
0120         *"1  ...   S/V"/
0121         *"2  ...   Scanner"/
0122         *"3  ...   Pacer"//" "A2)
0123      102 FORMAT (/"Enter S/V #, LO, HI"21X,2A2)
0124      103 FORMAT (/" Scannivalve #"I3/" Port"5X"Voltage")
0125      104 FORMAT (I4,F13.6"")
0126      105 FORMAT (/"Enter scanner #, LO, HI"17X,2A2)
0127      106 FORMAT (/5X"Scanner #"I3/" Chan"8X"Data")
0128      109 FORMAT (" Enter"//"A/D channel Pacer mode ",
0129         *"Blade pair Start count Increment ",
0130         *"Stop count # repetitions"A2//
0131         *7("    "),A2)
0132      110 FORMAT (7(I3,1X))
0133      111 FORMAT ("A/D channel Pacer mode Blade pair
0134         * Start count Increment Stop count",
0135         *" # repetitions"A2/I11,I11,I11,I12,I10,I11,I14,A2)
0136      107 FORMAT ("Enter YES to repeat"21X,2A2)
0137      108 FORMAT ("

Check completed")
```

```
0138     149 FORMAT ((3A2))
0139    1001 FORMAT ("F1R7M3A1H1T3")
0140    C       FORMATS CHECK STOP .
0141            DATA NOLF  /006537B/
0142            DATA NOCR  /000033B,040433B/
0143            DATA ICLR  /015524B,015515B,006537B/
0144
0145            LI = CNTRL(19)
0146            IF ( LO  .NE.  LI ) WRITE (LO,100)
0147       01   LINES = 0
0148    C       ..................................................................
0149    C       .                                                                .
0150    C       .  Ask operator what the instrument code is.                     .
0151    C       .                                                                .
0152    C       ..................................................................
0153            WRITE (LI, 101) NOLF
0154            READ  (LI,   *) IDUM
0155            WRITE (LI, 149) (ICLR,I=1,8)
0156            IF ( IDUM  .LT.  1   .OR.   IDUM  .GT.  3 ) GO TO 01
0157            GO TO (02,05,20) IDUM
0158    C       ..................................................................
0159    C       .                                                                .
0160    C       .  Check S/V;  Input S/V #, low port, high port.                 .
0161    C       .                                                                .
0162    C       ..................................................................
0163       02   WRITE (LI, 102) NOCR
0164            READ  (LI,   *) IPORT,ILOW,IHIGH
0165            WRITE (LI, 149) (ICLR,I=1,2)
0166            ISTEP = 1
0167            IF ( IPORT  .LT.  01     .OR.   IPORT  .GT.  05 ) GO TO 02
0168            IF ( ILOW   .LT.  01     .OR.   ILOW   .GT.  48 ) GO TO 02
0169            IF ( IHIGH  .LT.  ILOW   .OR.   IHIGH  .GT.  48 ) GO TO 02
0170            IF ( IPORT  .NE.  2 ) GO TO 03
0171            ISTEP = 2
0172            IF ( (ILOW /2)*2  .NE.  ILOW  ) ILOW =(ILOW /2)*2+2
0173            IF ( (IHIGH/2)*2  .NE.  IHIGH ) IHIGH=(IHIGH/2)*2+2
```

```
0174        03 IF ( LO   .NE.   LI ) WRITE (LO,103) IPORT
0175           WRITE (LI, 103)  IPORT
0176           LINES = LINES+3
0177   C       .....................................................................
0178   CCC     .                                                                   .
0179   CCC     .  Read & output voltages.                                          .
0180   CCC     .                                                                   .
0181   C       .....................................................................
0182           WRITE (10,1001)
0183           DO 04 I=ILOW,IHIGH,ISTEP
0184           IW = CNTRL(250)
0185           V = ACQN(IPORT,I,IW)
0186           IF ( LO   .NE.   LI ) WRITE (LO, 104) I,V
0187           WRITE (LI, 104) I,V
0188        04 LINES = LINES+1
0189           GO TO 07
0190   C       .....................................................................
0191   CCC     .                                                                   .
0192   CCC     .  Check scanner;  Input scanner #, low channel, high channel.      .
0193   CCC     .                                                                   .
0194   C       .....................................................................
0195        05 WRITE (LI, 105) NOCR
0196           READ  (LI,    *) ISCR,ILOW,IHIGH
0197           WRITE (LI, 149) (ICLR,I=1,2)
0198           IF ( ISCR   .EQ.   1 ) LS =  8
0199           IF ( ISCR   .EQ.   2 ) LS = 15
0200           IF ( ISCR   .LT.   1   .OR.   ISCR   .GT.   2 ) GO TO 05
0201           IF ( LO   .NE.   LI ) WRITE (LO, 106) ISCR
0202           WRITE (LI, 106) ISCR
0203           LINES = LINES+3
0204           ILOW = ILOW+1
0205           IHIGH = IHIGH+1
0206   C       .....................................................................
0207   CCC     .                                                                   .
0208   CCC     .  Read & output voltages.                                          .
0209   CCC     .                                                                   .
0210   C       .....................................................................
0211           WRITE (10,1001)
0212           DO 06 I=ILOW,IHIGH
0213           I1 = I-1
0214           D = SCANR(LS,I1,1)
0215           IF ( LO   .NE.   LI ) WRITE (LO, 104) I1,D
0216           WRITE (LI, 104) I1,D
0217        06 LINES = LINES+1
0218           GO TO 07
0219
0220   C       .....................................................................
0221   CCC     .                                                                   .
0222   CCC     .  Check pacer;  Input pacer control parameters.                    .
0223   CCC     .                                                                   .
0224   C       .....................................................................
0225        20 WRITE (LI, 109) (NOLF,I=1,2)
0226           READ  (LI, 110) ADCHNL,PAMO,PAIR,START,INCR,STOP,REP
0227           WRITE (LI, 149) (ICLR,I=1,5)
0228           WRITE (LI, 111) NOLF,ADCHNL,PAMO,PAIR,START,INCR,STOP,REP,NOLF
0229           LINES = LINES+2
0230           CALL RPACE (ADCHNL,PAMO,PAIR,START,INCR,STOP,REP,AVRGE,1,LO)
0231           LINES = LINES+3
0232
0233   C       .....................................................................
0234   CCC     .                                                                   .
0235   CCC     .  Ask whether to perform more test samples.                        .
0236   CCC     .                                                                   .
0237   C       .....................................................................
0238        07 WRITE (LI, 107) NOCR
0239           READ  (LI, 149) IDUM
0240           LINES = LINES+1
0241           WRITE (LI, 149) (ICLR,I=1,LINES)
0242           IF ( IDUM   .EQ.   2HYE ) GO TO 01
0243           IF ( LO   .EQ.   6 ) WRITE (LO, 108)
0244           RETURN
0245           END
```

```
PAGE 0008  CHECK  4:12 PM  TUE., 23  SEP., 1980

 FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

 **  NO WARNINGS **  NO ERRORS **   PROGRAM = 01030      COMMON = 00000
```

```
0246          SUBROUTINE CHNGE
0247    C     .....................................................................
0248    C     .                                                                   .
0249    C     .  Modify control array CNTRL(256) interactively.                   .
0250    C     .  Author:     Hans M. Zebner                                       .
0251    C     .  Date   :    January 11, 1980                                     .
0252    C     .  Detailed program description is available in TXCO log;  The      .
0253    C     .  Comment statements match to the flow chart explanations.         .
0254    C     .                                                                   .
0255    C     .....................................................................
0256          *, Enables user to change control array on-line.

0257          COMMON / CONTR / CNTRL
0258          INTEGER CNTRL(256)
0259          INTEGER INEW(3),NOLF,NOCR(2),ICLR(3)
0260
0261    C     FORMATS CHNGE START
0262      100 FORMAT (/" Enter"//
0263         *" C, I and new value of CNTRL(I)  ...   to
0264         * change the desired element I"/
0265         *" D, I"28X"...   to display the desired element I"
0266         */" R   "28X"...   to return to the calling program"//
0267         *"              "A2)
0268      101 FORMAT (A1,1X,I3,1X,3A2)
0269      102 FORMAT (I6)
0270      103 FORMAT ("CNTRL("I3") changed from "I6" to "I6" .")
0271      104 FORMAT ("CNTRL("I3") changed from   2H"A2" to   2H"A2" .")
0272      105 FORMAT (" Clear screen? YES or NO  "2A2)
0273      106 FORMAT ("The actual value of CNTRL("I3") is"I7" .")
0274      107 FORMAT ("The actual value of CNTRL("I3") is   2H"A2" .")
0275      149 FORMAT ((3A2))
0276    C     FORMATS CHNGE STOP
0277
0278          DATA NOLF   /006532B/
0279          DATA NOCR   /000033B,040433B/
0280          DATA ICLR   /015524B,015515B,006537B/
0281          LI    = CNTRL(19)
0282          ISCR  = 0
0283
0284
0285
0286    C     .....................................................................
0287    C     .                                                                   .
0288    C     .  Input instructions from keyboard.                                .
0289    C     .                                                                   .
0290    C     .....................................................................
0291        01 WRITE (LI, 100) NOLF
0292           READ  (LI, 101) IDUM,ICNT,INEW
0293           WRITE (LI, 149) (ICLR,I=1,8)
0294           IF ( IDUM  .EQ.  2HC  ) GO TO 02
0295           IF ( IDUM  .EQ.  2HD  ) GO TO 05
0296           IF ( IDUM  .EQ.  2HR  ) GO TO 06
0297           GO TO 01
0298
0299
0300
0301    C     .....................................................................
0302    C     .                                                                   .
0303    C     .  Change desired element of control array CNTRL.                   .
0304    C     .                                                                   .
0305    C     .....................................................................
0306        02 ISCR = ISCR+1
0307           IOLD  = CNTRL(ICNT)
0308           IF ( INEW(2)  .NE.  2H2H ) GO TO 03
0309           CNTRL(ICNT) = INEW(3)
0310           GO TO 04
0311        03 CALL CODE
0312           READ (INEW, 102) CNTRL(ICNT)
0313        04 IF ( INEW(2)  .NE.  2H2H ) WRITE (LI, 103) ICNT,IOLD,CNTRL(ICNT)
0314           IF ( INEW(2)  .EQ.  2H2H ) WRITE (LI, 104) ICNT, IOLD, CNTRL(ICNT)
0315
0316           GO TO 01
0317
0318
0319
0320    C     .....................................................................
```

```
0321   C      .
0322   C      .  Display desired element of control array CNTRL.
0323   C      .
0324   C      ..................................................................
0325        05 ISCR = ISCR+1
0326           IF ( INEW(2)  .NE.  2H2H ) WRITE (LI, 106) ICNT,CNTRL(ICNT)
0327           IF ( INEW(2)  .EQ.  2H2H ) WRITE (LI, 107) ICNT, CNTRL(ICNT)
0328
0329           GO TO 01
0330
0331
0332
0333   C      ..................................................................
0334   C      .
0335   C      .  Terminate modification of control array CNTRL;  write it
0336   C      .  back to the disc;  return to calling program.
0337   C      .
0338   C      ..................................................................
0339        06 WRITE (LI, 105) NOCR
0340           READ  (LI, 149) IDUM
0341           IF ( IDUM  .EQ.  2HNO   ) GO TO 07
0342           IF ( ISCR  .GT.  0 ) WRITE (LI, 149) (ICLR,I=1,ISCR)
0343        07 WRITE (LI, 149) ICLR
0344           CALL REWRF (1,2)
0345           RETURN
0346           END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 00581 COMMON = 00000

7. UTILITY SUBROUTINE PACKAGE TXCOU

7.1. Description

Subroutines and functions, which are commonly used by either TXCO2, TXCO2 or TXCO3, are contained in the utility package TXCOU (source code is saved in file &TXCOU; relocatable binary code is saved in file %TXCOU). Thus the length of the TXCO1, TXCO2 or TXCO3 source files can be kept to minimum, which allows editing and recompiling TXCO1, -2, -3 separately, which saves time. When loading TXCO1, -2, -3, the load of the utility subroutines has to be included using the multiple search loader command (MS,%TXCOU). Since the utility subroutines and functions are short and straightforward, the comment statements and program explanation included in the code serve to describe them. The present section briefly outlines the utility subroutine package.

Name	Purpose	Author
ACQN	Positions Scanivalve (S/V) and reads DVM	Geopfarth
CNTL	Closes scanner channels, which control the S/V controller, HG78K	Geopfarth
CURVE	Computes coefficients for a linear curve fit	McGuire
ICON	Converts a one or two digit integer into a two character ASCII string	Geopfarth

Name	Purpose	Author
IPORT	Interrogates S/V controller and returns the present port #	Geopfarth
PICTR	Uses the (24 x 80 dot) CRT of a terminal for a graphics display of data acquired with the PACER	Zebner
REWRF	Data transfer disc file to program array and vice versa	Zebner
RPACE	Triggers A/D through the PACER and calculates the average voltage	Zebner
SCANR	Closes scanner channel and reads the DVM or digital counter	Geopfarth
TIME	Obtains date and time in ASCII-format	Zebner
WAIT	Causes a defined time delay	Geopfarth (Original) Zebner (Modification)

REAL FUNCTION ACQN

Arguments: INTEGER: IVALVE, IADES, IW

IVALVE - - - Desired S/V #

IADES - - - Desired port # of S/V

IW - - - - - Time delay in tens of ms between closing transducer relay and taking the DVM reading

Example: The pressure on S/V #4, Port #18 is to be read with the time delay to be 0.5 sec (= 500 ms = 50 x 10 ms). The correct call is

```
IVALVE = 4
IPORT = 18
IW = 50
PRES = ACQN (IVALVE, IPORT, IW)
```

or

```
PRES = ACQN (4, 18, 50)
```

In both cases the DVM reading is written into the real variable PRES.

It is desirable to step forwards systematically and sequentially through the required parts of a S/V in order to reduce unnecessary wear. Whenever a S/V is scanned, the operator should watch the data system closely. In some cases (e.g. if the HP 9830 is brought on line) the HP-Interface bus and the devices may be downed. If this happens when the program ACQN has closed the scanner channels (on scanner #1) which either resets or advances the S/V the S/V relay will burn out. To prevent damage, the operator must turn off the power to scanner #1 immediately, then bring the data system up again using the UP-command (see HP manuals).

SUBROUTINE CNTL (ICHAN, IDEL, ISTEP, K)

Arguments: INTEGER: ICHAN, IDEL, ISTEP, K

ICHAN - - - Channel # of scanner #1 (LU# = 8)

IDEL - - - Number of repetitions to close the scanner channel

ISTEP - - - Increment to step from 1 through IDEL

K - - - - - Function code

K = 1 Close for 10 ms, wait for 150 ms; Repeat "IDEL" times; return

K = 2 Close for 10 ms, wait for 4 sec; return

K = 3 Close; return

An example is unnecessary since the only subroutine to use SUBROUTINE CNTL is the REAL FUNCTION ACQN, which is itself a utility. The user won't have to deal with CNTL.

SUBROUTINE CURVE (N, X, Y, SLOPE, SECON)

Arguments: INTEGER: N

REAL: X(N), Y(N), SLOPE, SECON

N - - - - Number of data points

X(N) - - - Abscissa of data points

Y(N) - - - Ordinals of data points

SLOPE - - Slope of linear curve fit

SECON - - Intercept of linear curve fit

Example: Suppose the following (N = 6) pairs of data points shall be approximated by a linear curve fit:

X(1) = 1.0 Y(1) = 105.6

X(2) = 2.5 Y(2) = 105.4

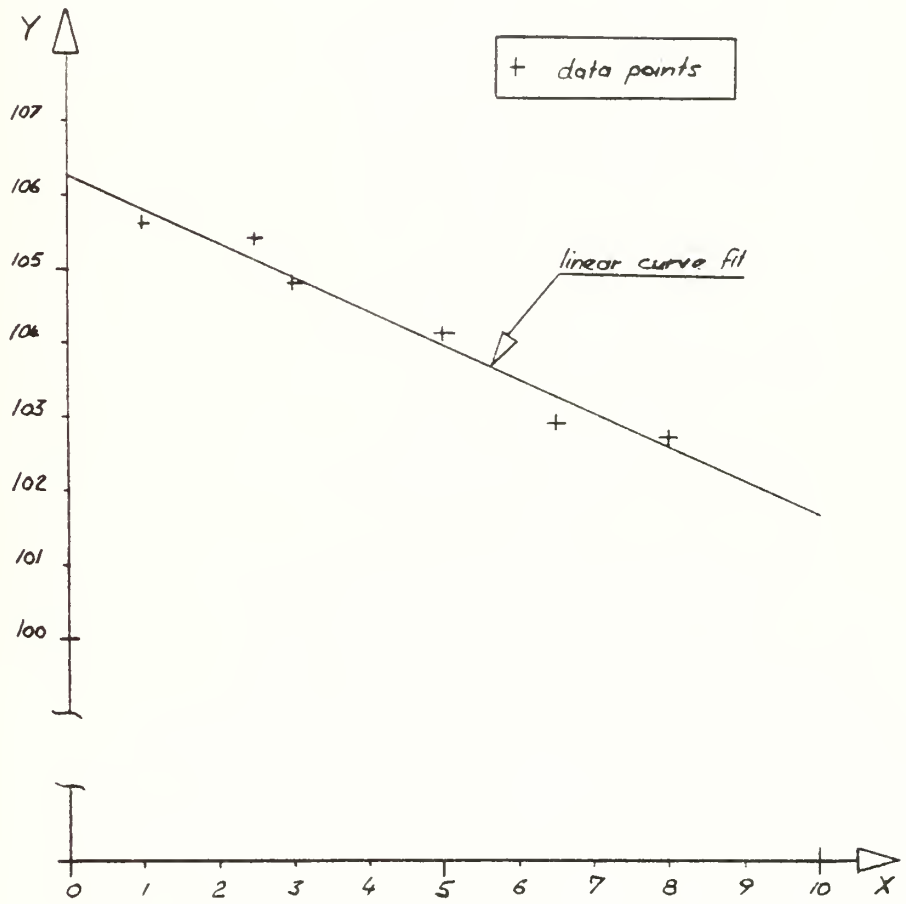
X(3) = 3.0 Y(3) = 104.8

X(4) = 5.0 Y(4) = 104.1

X(5) = 6.5 Y(5) = 102.9

X(6) = 8.0 Y(6) = 102.7

The situation is shown in the following sketch:



To obtain the slope and the intercept of the linear curve fit (which is derived using the least squares criterion), program

CALL CURVE (6, X, Y, SLOPE, SECON)

and the results will be returned from SUBROUTINE CURVE

SLOPE = -.461

SECON = 106.247

INTEGER FUNCTION ICON

Arguments: INTEGER: I, N

I, N - - - Two integer numbers to be added

ICON - - - The result of the addition (which should not exceed two digits), but ASCII converted.

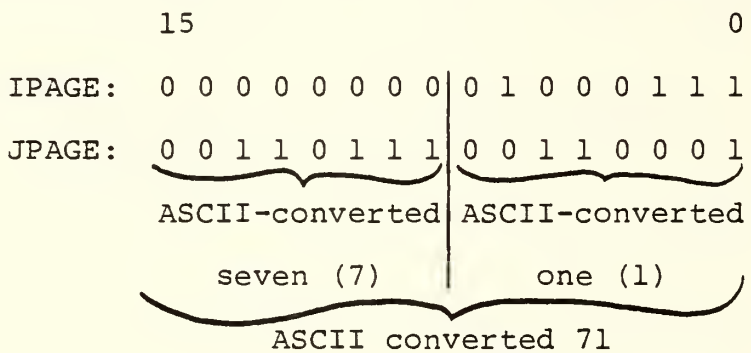
Example: Suppose the data documentation page IPAGE shall be converted to an ASCII-string named JPAGE. The correct call is:

JPAGE = ICON (IPAGE, Ø)

or

JPAGE = ICON (Ø, IPAGE)

The bit structure, if IPAGE is 71_{10}, is as follows:



INTEGER FUNCTION IPORT

Arguments: INTEGER: IVALVE

IVALVE - - - Desired S/V (1 through 5)

Example: The call

IWHERE = IPORT(5)

returns the present port # of S/V #5 and writes it into the variable IWHERE.

SUBROUTINE PICTR

Arguments: INTEGER: LO, NUMBER, NEWPG, ICL, ISIGN

REAL: AMPL

LO - - - - Defines terminal LU# (either 1 or 18)

NUMBR - - Identifier to appear in the "drawing"

NEWPG - - No significance! Will be altered by PICTR

ICL - - - No significance! Will be altered by PICTR

ISIGN - - Character to be used for the drawing

AMPL - - - Amplitude range of the raw data returned to the calling program

Subroutine PICTR is designed for the TXCOl-subroutine PACER, from which it gets the data through the COMMON block CIBUF. PICTR uses the enhanced display capabilities of the video terminal to produce a "drawing" which, of course, is of limited resolution. It allows the operator to verify the acquired raw paced run data qualitatively by checking the "drawing" against the oscilloscope display. See the listing of subroutine PACER, if an example is needed.

SUBROUTINE REWRF

Arguments: INTEGER: IREWRF, IWHATA

IREWRF - - Determines whether the array indicated by IWHATA shall be read from a disc file into an array or whether it shall be written into a disc file

IREWRF = -1 Read data from disc file into array

IREWRF = +1 Write data from array into disc file

IWHATA - - Specifies the type of data to be transferred

IWHATA = 1 Array IBUF ↔ disc file IBUFF

IWHATA = 2 Array CNTRL ↔ disc file CNTRLF

This subroutine relieves the individual TXCO1, -2, -3 subroutines from the routine task of data transfer between disc and program (CP).

Example: The four applications are:

i) Read the program control array from disc file CNTRLF::26 into array CNTRL: CALL REWRF (-1, 2)

ii) Write the program control array from array CNTRL into disc file CNTRLF::26: CALL REWRF (1, 2)

iii) Read the raw data buffer from disc file IBUFF::26 into array IBUF: CALL REWRF (-1, 1)

iv) Write the raw data buffer from array IBUF into disc file IBUFF::26: CALL REWRF (1, 1)

SUBROUTINE RPACE

Arguments: INTEGER: ADCHNL, PAMO, PAIR, START, INCR, STOP, REP, IPRINT, LO

REAL: AVRGE

ADCHNL - - A/D input channel to be selected (0...15)

PAMO - - - Pacer mode (1 or 2)

PAIR - - - Blade pair (1...9)

START - - - Start location (in counts) for data scan across the blade passage

INCR - - - Step size (in counts) to scan across the blade passage

STOP - - - Stop location (in counts) for data scan across the blade passage.

REP - - - - Number of repetitions at each location in the blade passage

IPRINT - - Flag to decide whether to output intermediate information

IPRINT = 1 Print all intermediate data and suppress pointer at the terminal

IPRINT = Ø Suppress printed output and initialize pointer at the terminal

LO - - - - LU# of device for printed output

AVRGE - - - Average voltage of paced run data

This subroutine is the control program to acquire data from the A/D converter in the synchronized PACER mode. (See also the description of subroutine PACER (Section 4.5), where the synchronized sampling is explained.) Although the (decoded) voltages from the A/D converter are REAL numbers between -1.0 volt and +1.0 volt, the data storage uses an integer array. Before writing the voltages into the data array, they are multiplied by 10,000. Note that if one of the PACER control parameters is out of the defined range, it is set to a default value without outputting any warning. The subroutine contains a large number of I/O statements

which were necessary during the development of the TXCO program system. In order to increase speed, the unnecessary statements should be removed. A further improvement would be a conversion from FORTRAN to ASSEMBLER programming language. An example of a call to subroutine RPACE is contained in the description and listing of subroutine PACER (Section 4.5).

REAL FUNCTION SCANR

Arguments: INTEGER: LU, ICHAN, K

LU - - - - Logical Unit # of the desired scanner (either 8 - scanner #1, or 15 - scanner #2)

ICHAN - - - Scanner channel (integer)

K - - - - - Instrument code

K = 1 Read the DVM

K = 2 Read the digital counter

Example A: To obtain the torque reading from the transonic compressor test rig, which is fed into scanner #1 (LU = 8), channel 36, program

```
LU = 8
ICHAN = 36
K = 1
TORQUE = SCANR (LU, ICHAN, K)
or
TORQUE = SCANR (8, 36, 1)
```

In both cases the DVM reading is written into the real variable TORQUE.

Example B: To obtain the RPM of the Allis-Chalmers (central air supply) compressor, program

```
LU = 8
ICHAN = 15
K = 2
RPMAC = SCANR (LU, ICHAN, K)
or
RPMAC = SCANR (8, 15, 2)
```

In both cases the reading of the digital counter is written into the real variable RPMAC.

Example	Instrument Code	Instrument Read
A	1	Digital Voltmeter
B	2	Digital Counter

SUBROUTINE TIME

Arguments: INTEGER: IMON, IDAY, IYEAR, IHOUR, IMIN, ISEC

IMON - - - ASCII converted month of the year

IYEAR - - - ASCII converted last two digits of current year

IDAY - - - ASCII converted day of the month

IHOUR - - - ASCII converted hour (24-hour clock) of the day

IMIN - - - ASCII converted minute of the hour

ISEC - - - ASCII converted second of the minute

IMON, IDAY and IYEAR are obtained from the program control array; IHOUR, IMIN and ISEC are obtained from the system

clock through an EXEC call; all variables are returned to the calling program.

Example: Suppose the system clock is set correctly and the control array CNTRL is defined, i.e., CNTRL was read from the disc file and adjusted to the actual conditions; then the following code

```
          .
          .
          .
      603 FORMAT ("Date & Time: "A2"/"A2"/"A2,2X,
         *A2":"A2)
          CALL TIME (IMON,IDAY,IYEAR,IHOUR,IMIN,ISEC)
          WRITE (6,6Ø9) IMON,IDAY,IYEAR,IHOUR,IMIN
          .
          .
          .
```

produces the following output:

```
          .
          .
          .
      Date & Time:  Ø9/27/8Ø  21:57
          .
          .
          .
```

SUBROUTINE WAIT

Arguments: INTEGER: TWAIT

TWAIT - - - Time delay in tens of milliseconds

Example: To cause a defined time delay of 5,7 sec (= 5700 ms = 570 x 10 ms), program

```
ITWAIT = 570
CALL WAIT (ITWAIT)
```

or

```
CALL WAIT (570)
```

7.2. PROGRAM LISTING TXCOU

```
 PAGE 0001  FTN.   9:57 PM  SAT., 27  SEP., 1980

0001   FTN4,L
0002         REAL FUNCTION ACQN (IVALVE,IADES,IW)
0003   C     .....................................................................
0004   C     .                                                                   .
0005   C     .  Position scannivalve IVALVE to port IADES and define ACQN        .
0006   C     .  the DVM output voltage.  A time delay of (IWAIT*10) ms occurs    .
0007   C     .  between port selection and voltage measurement.  The DVM is      .
0008   C     .  triggered by issuing HP-IB subroutine TRIGR.                     .
0009   C     .  Author:    Robert N. Geopfarth                                   .
0010   C     .  Date:      January 31, 1979                                      .
0011   C     .  A detailed program description is available in TXCO log.  The    .
0012   C     .  variables are:                                                   .
0013   C     .  IVALVE ...   Desired S/V.                                        .
0014   C     .  IADES  ...   Desired S/V port #.                                 .
0015   C     .  IAPR   ...   Present S/V port #.                                 .
0016   C     .  ICHAN  ...   ASCII converted scanner channel.                    .
0017   C     .  ACQN   ...   Transducer voltage as read from DVM.                .
0018   C     .  IW     ...   Time delay factor.                                  .
0019   C     .                                                                   .
0020   C     .....................................................................
0021         *, Positions scannivalve and reads DVM.   Utilities.
0022      801 FORMAT ("C")
0023      901 FORMAT (/" ****   ERROR DETECTED IN REAL FUNCTION ACQN;"/
0024     *           " ****         CHECK FOR BAD PARAMETER IN CALL!"/
0025     *           " ****   IVALVE ="I3"    IADES ="I3"    IW ="I4/)
0026
0027         ISTEP = 1
0028         IF ( IVALVE  .LT.  1   .OR.   IVALVE  .GT.   5 ) GO TO  06
0029         IF ( IADES   .LT.  1   .OR.   IADES   .GT.  48 ) GO TO  06
0030         IF ( IVALVE  .EQ.  2   .OR.   IVALVE  .EQ.   3 ) ISTEP = 2
0031
0032   C     .....................................................................
0033   C     .                                                                   .
0034   C     .  Compare present port # to desired port#.                         .
0035   C     .                                                                   .
0036   C     .....................................................................
0037      01 IAPR = IPORT(IVALVE)
0038         IDEL = IADES-IAPR
0039         IF ( IDEL ) 02,03,04
0040
0041   C     .....................................................................
0042   C     .                                                                   .
0043   C     .  Desired port below present port;  reset S/V                      .
0044   C     .                                                                   .
0045   C     .....................................................................
0046      02 ICHAN = ICON(IVALVE,4)
0047         K = 2
0048         GO TO 05
0049
0050   C     .....................................................................
0051   C     .                                                                   .
0052   C     .  Present port is present port;  close X-ducer relay & read        .
0053   C     .                                                                   .
0054   C     .....................................................................
0055      03 ICHAN = ICON(IVALVE,9)
0056         K = 3
0057         GO TO 05
0058
0059   C     .....................................................................
0060   C     .                                                                   .
0061   C     .  Desired port is above present port;  advance S/V.                .
0062   C     .                                                                   .
0063   C     .....................................................................
0064      04 ICHAN = ICON(IVALVE,-1)
0065         K = 1
0066
0067   C     .....................................................................
0068   C     .                                                                   .
0069   C     .  Control S/V.                                                     .
0070   C     .                                                                   .
0071   C     .....................................................................
0072      05 CALL CNTL (ICHAN,IDEL,ISTEP,K)
0073         IF ( K   .NE.  3 ) GO TO 01
0074
0075   C     .....................................................................
0076   C     .
```

```
0077   C      . Pause and read transducer output voltage.                    .
0078   C      . .                                                            .
0079   C      ..............................................................
0080          CALL WAIT (IW)
0081          CALL TRIGR (10)
0082          READ  (10,   *) DUM
0083          CALL TRIGR (10)
0084          READ  (10,   *) ACQN
0085          WRITE ( 8, 801)
0086          RETURN
0087
0088   C      ..............................................................
0089   C      .                                                              .
0090   C      .  Error encountered;  output error message;  return.          .
0091   C      .                                                              .
0092   C      ..............................................................
0093       06 WRITE ( 6, 901) IVALVE,IADES,IW
0094          RETURN
0095          END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 00237 COMMON = 00000

```
PAGE 0003  FTN.   9:57 PM  SAT., 27  SEP., 1980

0096          SUBROUTINE CNTL(ICHAN,IDEL,ISTEP,K)
0097         *, Closes scanner channel.                    *
0098    C
0099    C               THIS PROGRAM CLOSES SCANNER CHANNEL "ICHAN"
0100    C               "IDEL" TIMES IN STEPS OF "ISTEP" BASED UPON
0101    C               PROGRAM OPTIONS SPECIFIED BY "K". (ICHAN MUST
0102    C               BE AN ASCII-CONVERTED INTEGER.)
0103    C
0104    C                K            FUNCTION
0105    C               ---  ------------------------------
0106    C                1   CLOSE FOR 10-MS  WAIT FOR
0107    C                    150-MS.  REPEAT "IDEL" TIMES.
0108    C
0109    C                2   CLOSE FOR 10-MS  WAIT FOR
0110    C                    4-SEC  RETURN.
0111    C
0112    C                3   CLOSE  RETURN.
0113    C               ---  ------------------------------
0114    C
0115    C       AUTHOR: R.N. GEOPFARTH,LT USN
0116    C       DATE:   JAN 79
0117    C
0118          GO TO(100,200,300),K
0119    C
0120    100   DO 10 I=1,IDEL,ISTEP
0121          WRITE(8,60)ICHAN
0122          CALL WAIT(1)
0123          WRITE(8,62)
0124          CALL WAIT(15)
0125    10    CONTINUE
0126          RETURN
0127    C
0128    200   WRITE(8,60)ICHAN
0129          CALL WAIT(1)
0130          WRITE(8,62)
0131          CALL WAIT(400)
0132          RETURN
0133    C
0134    300   WRITE(8,60)ICHAN
0135          RETURN
0136    C
0137    60    FORMAT(A2)
0138    62    FORMAT("C")
0139          END

 FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

 **  NO WARNINGS **  NO ERRORS **   PROGRAM = 00088      COMMON = 00000
```

```
0140          SUBROUTINE CURVE (N,X,Y,SLOPE,SECON)
0141    C     .....................................................
0142    C     .                                                   .
0143    C     .  Compute linear curve fit using least square root method.
0144    C     .  Author:     Alan G. McGuire                      .
0145    C     .  Date:       February 21, 1980                    .
0146    C     .  A detailed program description is available in TXCO log.  The
0147    C     .  comment statements and statement numbers match to the ones
0148    C     .  used in the flow chart.                          .
0149    C     .                                                   .
0150    C     .....................................................
0151         *, Computes linear curve fit.
0152          REAL X(N),Y(N)
0153          SUMP0 = 0.
0154          SUME0 = 0.
0155          SUMVP = 0.
0156          SUME2 = 0.
0157          DO 1 I=1,N,1
0158          SUME0 = SUME0 + X(I)
0159          SUMP0 = SUMP0 + Y(I)
0160          SUMVP = SUMVP + (X(I)*Y(I))
0161       01 SUME2 = SUME2 + X(I)*X(I)
0162          RN = FLOAT(N)
0163          SNUM = (RN*SUMVP) - (SUME0*SUMP0)
0164          SDEN = (RN*SUME2) - (SUME0*SUME0)
0165          SLOPE = SNUM/SDEN
0166          SECON = (SUMP0-(SLOPE*SUME0))/RN
0167          RETURN
0168          END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 00176 COMMON = 00000

```
0169          INTEGER FUNCTION ICON (I,N)
0170    C     .....................................................................
0171    C     .                                                                   .
0172    C     .  Converts integer numbers into ASCI string.                       .
0173    C     .  Author:     Robert N. Geopfarth                                  .
0174    C     .  Date:       January 31, 1979                                     .
0175    C     .  Because of the simplicity of the program the program             .
0176    C     .  description is included in this box.                             .
0177    C     .  I, N    ...   integer numbers to be added.                       .
0178    C     .  IC      ...   integer number to be converted into ASCII.         .
0179    C     .  ICON    ...   2 - character ASCII string to be returned          .
0180    C     .                                                                   .
0181    C     .....................................................................
0182          *, Converts integer to ASCII-string.
0183       100 FORMAT (I2)
0184
0185          IC = I+N
0186          IF ( IC  .LT.  10 ) GO TO 01
0187
0188          CALL CODE
0189          WRITE (ICON,100) IC
0190          RETURN
0191
0192       01 ICON = IC+30060B
0193          RETURN
0194          END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 00036 COMMON = 00000

```
0195          INTEGER FUNCTION IPORT (IVALVE)
0196         *, Interrogates scanivalve.                "
0197    C
0198    C               THIS PROGRAM INTERROGATES SCANIVALVE
0199    C               "IVALVE" AND CONVERTS PORT ADDRESS
0200    C               INTO A DECIMAL VALUE.
0201    C
0202    C               VARIABLES:
0203    C
0204    C                  IVALVE = DESIRED S/V
0205    C                  IP     = S/V INPUT BUFFER
0206    C                  MSD    = MOST  SIGNIF. DIGIT
0207    C                  LSD    = LEAST SIGNIF. DIGIT
0208    C                  IPORT  = DECIMAL S/V ADDRESS
0209    C
0210    C       AUTHOR: R.N. GEOPFARTH,LT USN
0211    C       DATE:   DEC 78
0212    C
0213          LU = 14 + 2100B
0214          CALL EXEC(2,LU,IVALVE*256,-1)
0215          CALL EXEC(1,LU,IP,-1)
0216          IP=IP/256
0217          MSD = IAND(IP/16,7B)
0218          LSD = IAND(IP,17B)
0219          IPORT = 10*MSD + LSD
0220          RETURN
0221          END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 00064 COMMON = 00000

```
0222          SUBROUTINE PICTR (LO,NUMBR,NEWPG,ICL,ISIGN,AMPL)
0223    C     .....................................................................
0224    CC    .                                                                   .
0225    CC    .  Use terminal screen for grafic display.                          .
0226    CC    .                                                                   .
0227    C     .....................................................................
0228         *, Use CRT to display the acquired data.    "
0229          COMMON / CIBUF / IBUF
0230          REAL CLR(64)
0231          INTEGER IBUF(1664)
0232          INTEGER NOLF,NOCR(2),ICLR(3),PLOT(8)
0233          INTEGER BLACK(2),GREY(2),WHITE(2),BG(2),LN(2),TEXT(20),HJF(3)
0234          DATA NOLF   /006537B/
0235          DATA NOCR   /000033B,040433B/
0236          DATA ICLR   /015524B,015515B,006537B/
0237          DATA BLACK  /015446B,062100B/
0238          DATA WHITE  /015446B,062102B/
0239          DATA GREY   /015446B,062112B/
0240          DATA HJF    /015510B,015512B,015506B/
0241          DATA ICLEAR /2H   /
0242    C     FORMATS  PICTR  START
0243     1801 FORMAT (2A2,79X,3A2)
0244     1803 FORMAT (A2"a"I3"r"I3"CFigure"I3"; "20A2)
0245     1805 FORMAT (2A2,8X,2A2,65X,2A2,6X,3A2)
0246     1806 FORMAT (A2"a"I3"r"I3"C"F6.3)
0247     1807 FORMAT (2A2,8X,2A2,1X,4(2A2,15X,2A2,1X),2A2,6X)
0248     1809 FORMAT (" "F8.3,4F16.3)
0249     1817 FORMAT (8A2)
0250     1819 FORMAT (A2"a"I3"r"I3"C"A1,2A2)
0251    C     FORMATS  PICTR  STOP
0252          IF ( IFRST  .EQ.  1 ) GO TO 21
0253          IFRST = 1
0254          NEWPG = 1
0255       21 IF ( NEWPG  .EQ.  1 ) ICL = 0
0256          IF ( LO  .EQ.  1 ) GO TO 01
0257          IF ( LO  .EQ.  18 ) GO TO 02
0258       01 LN(1) = GREY(1)
0259          LN(2) = GREY(2)
0260          GO TO 03
0261       02 LN(1) = BLACK(1)
0262          LN(2) = BLACK(2)
0263       03 BG(1) = WHITE(1)
0264          BG(2) = WHITE(2)
0265          IF ( ICL  .NE.  1 ) GO TO 25
0266    C     .....................................................................
0267    CC    .                                                                   .
0268    CC    .  Clear dots in frame w/o erasing the frame.                       .
0269    CC    .                                                                   .
0270    C     .....................................................................
0271       11 IROW = 11
0272          ICOL = 7
0273          CALL CODE
0274          WRITE (PLOT,1819) BLACK(1),IROW,ICOL,ICLEAR,NOCR
0275          WRITE (LO,1817) PLOT
0276          DO 13 I=1,64
0277          DO 12 J1=1,21
0278          J = J1-11
0279          X = J
0280       12 IF ( CLR(I)  .GE.  X-0.5  .AND.  CLR(I)  .LT.  X+0.5 ) NUPDN = J
0281          IROW = 11-NUPDN
0282          ICOL = 7+I
0283          CALL CODE
0284          WRITE (PLOT,1819) BLACK(1),IROW,ICOL,ICLEAR,NOCR
0285       13 WRITE (LO,1817) PLOT
0286    C     .....................................................................
0287    CC    .                                                                   .
0288    CC    .  Get the curve in the format required by PICTR.                   .
0289    CC    .                                                                   .
0290    C     .....................................................................
0291       25 J=0
0292          DO 04 I=1,256,4
0293          J=J+1
0294       04 CLR(J) = IBUF(I)/10000.
0295          XMIN = CLR(1)
0296          XMAX = CLR(1)
0297          IF ( ICL  .EQ.  1 ) GO TO 43
```

```
0298          DO 41 I=1,64
0299          IF ( CLR(I)  .GT.  XMAX ) XMAX = CLR(I)
0300       41 IF ( CLR(I)  .LT.  XMIN ) XMIN = CLR(I)
0301          AMPL = XMAX
0302          IF ( ABS(XMIN)  .GT.  XMAX ) AMPL = -XMIN
0303          IF ( AMPL  .LE.   0.001   .AND.   AMPL  .GT.   0.000 ) AMPL= 0.001
0304          IF ( AMPL  .LE.   0.002   .AND.   AMPL  .GT.   0.001 ) AMPL= 0.002
0305          IF ( AMPL  .LE.   0.010   .AND.   AMPL  .GT.   0.005 ) AMPL= 0.010
0306          IF ( AMPL  .LE.   0.020   .AND.   AMPL  .GT.   0.010 ) AMPL= 0.020
0307          IF ( AMPL  .LE.   0.050   .AND.   AMPL  .GT.   0.020 ) AMPL= 0.050
0308          IF ( AMPL  .LE.   0.100   .AND.   AMPL  .GT.   0.050 ) AMPL= 0.100
0309          IF ( AMPL  .LE.   0.200   .AND.   AMPL  .GT.   0.100 ) AMPL= 0.200
0310          IF ( AMPL  .LE.   0.500   .AND.   AMPL  .GT.   0.200 ) AMPL= 0.500
0311          IF ( AMPL  .LE.   1.000   .AND.   AMPL  .GT.   0.500 ) AMPL= 1.000
0312          IF ( AMPL  .LE.   2.000   .AND.   AMPL  .GT.   1.000 ) AMPL= 2.000
0313          IF ( AMPL  .LE.   5.000   .AND.   AMPL  .GT.   2.000 ) AMPL= 5.000
0314          IF ( AMPL  .LE.  10.000   .AND.   AMPL  .GT.   5.000 ) AMPL=10.000
0315       43 CONTINUE
0316          DO 42 I=1,64
0317       42 CLR(I) = CLR(I)*(10.0/AMPL)
0318          IF ( NEWPG  .NE.  1 ) GO TO 31
0319    C     .....................................................................
0320    CC    .                                                                   .
0321    CC    .  New frame.                                                       .
0322    CC    .                                                                   .
0323    C     .....................................................................
0324       05 WRITE (LO,1817) HJF(1),HJF(2),NOLF
0325          WRITE (LO,1801) BG,BLACK
0326          WRITE (LO,1805) BG,LN,BG,BLACK
0327          DO 06 I=1,9
0328       06 WRITE (LO,1807) BG,LN,BG,LN,BG,LN,BG,LN,BG,LN,BG
0329          WRITE (LO,1805) BG,LN,BG,BLACK
0330          DO 07 I=1,9
0331       07 WRITE (LO,1807) BG,LN,BG,LN,BG,LN,BG,LN,BG,LN,BG
0332          WRITE (LO,1805) BG,LN,BG,BLACK
0333          WRITE (LO,1801) BG,BLACK
0334          WRITE (LO,1801) BG,BLACK,NOLF
0335    C     .....................................................................
0336    CC    .                                                                   .
0337    CC    .  Label the existing frame.                                        .
0338    CC    .                                                                   .
0339    C     .....................................................................
0340       31 ZERO  = 0.
0341          AMPLM = -AMPL
0342          IROW  = 0
0343          ICOL  = 8
0344          WRITE (LO,1803) BLACK(1),IROW,ICOL,NUMBR,TEXT
0345          IROW  = 1
0346          ICOL  = 2
0347          WRITE (LO,1806) BLACK(1),IROW,ICOL,AMPL
0348          IROW  = 11
0349          WRITE (LO,1806) BLACK(1),IROW,ICOL,ZERO
0350          IROW  = 21
0351          WRITE (LO,1806) BLACK(1),IROW,ICOL,AMPLM
0352    C     .....................................................................
0353    CC    .                                                                   .
0354    CC    .  Plot curve into frame.                                           .
0355    CC    .                                                                   .
0356    C     .....................................................................
0357       08 CONTINUE
0358          DO 10 I=1,64
0359          DO 09 J1=1,21
0360          J = J1-11
0361          X = J
0362       09 IF ( CLR(I)  .GE.  X-0.5   .AND.   CLR(I)  .LT.  X+0.5 ) NUPDN = J
0363          IROW = 11-NUPDN
0364          ICOL = 7+I
0365          CALL CODE
0366          WRITE (PLOT,1819) BLACK(1),IROW,ICOL,ISIGN,NOCR
0367       10 WRITE (LO,1817) PLOT
0368          IROW = 11
0369          ICOL = 7
0370          CALL CODE
0371          WRITE (PLOT,1819) BLACK(1),IROW,ICOL,ICLEAR,NOCR
0372          WRITE (LO,1817) PLOT
0373          RETURN
```

```
 PAGE 0009  PICTR  9:57 PM  SAT., 27  SEP., 1980

0374          END

  FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

  **  NO WARNINGS **  NO ERRORS **   PROGRAM = 01345      COMMON = 00000
```

```
0375          SUBROUTINE REWRF (IREWR,IWHATA)
0376    C     .....................................................................
0377    C     .                                                                   .
0378    C     .  This subroutine reads (IREWR = -1) or writes (IREWR = +1) of    .
0379    C     .  of a array specified by IWHATA.                                  .
0380    C     .  Author:    Hans M. Zebner                                        .
0381    C     .  Date  :    February 08, 1980                                     .
0382    C     .  Detailed program description is available in TXCO log;  The     .
0383    C     .  Comment statements match to the flow chart explanations.         .
0384    C     .                                                                   .
0385    C     .....................................................................
0386          *, Data transfer disc    array.
0387           COMMON / CIBUF / IBUF
0388           COMMON / CONTR / CNTRL
0389    C      COMMON / CA    / A
0390           COMMON / FMP   / IDCB,IFILE,ISIZE
0391    C      REAL A(256)
0392           INTEGER IBUF(1664)
0393           INTEGER IDCB(144),IFILE(3),ISIZE(2)
0394           INTEGER NOLF,NOCR(2),ICLR(3)
0395           DATA NOLF  /006537B/
0396           DATA NOCR  /000033B,040433B/
0397           DATA ICLR  /015524B,015515B,006537B/
0398    C      FORMATS  REWRF  START
0399       101 FORMAT ("  REWRF : ARRAY IBUF(1664)   DISC FILE IBUFF
0400          *:00:26")
0401       102 FORMAT ("  REWRF : DISC FILE IBUFF:00:26   ARRAY IBUF(1664)")
0402       103 FORMAT ("  REWRF : ARRAY CNTRL(256)   DISC FILE CNTRLF:00:26"
0403          *)
0404       104 FORMAT ("  REWRF : DISC FILE CNTRLF:00:26   ARRAY CNTRL(256)"
0405          *)
0406       105 FORMAT ("  REWRF : ARRAY A(256)   DISC FILE AF:00:26")
0407       106 FORMAT ("  REWRF : DISC FILE AF:00:26   ARRAY A(256)")
0408       107 FORMAT ("  REWRF : ERROR RETURN (IWHATA ="I3")")
0409       108 FORMAT ("IBUFF ")
0410       109 FORMAT ("CNTRLF")
0411       110 FORMAT ("AF    ")
0412       121 FORMAT (" CALL OPEN  (IDCB,IERR,"3A2","I2","I2","I2","I4"
0413          *)  failed; STOP"21X"")
0414       122 FORMAT (" CALL LOCF  (IDCB,IERR,IDUM,IDUM,IDUM,ISIZE(1),I
0415          *DUM,IDUM,ISIZE(2)) failed; STOP")
0416       123 FORMAT (" CALL RWNDF (IDCB,IERR)  failed; STOP"42X"")
0417       124 FORMAT (" CALL READF (IDCB,IERR,IBUF,"I3","I2","I2")  fai
0418          *led; STOP"27X"")
0419       125 FORMAT (" CALL WRITF (IDCB,IERR,IBUF,"I3","I2","I2")  fai
0420          *led; STOP"26X"")
0421       126 FORMAT (" CALL READF (IDCB,IERR,CNTRL,"I3","I2","I2")  fa
0422          *iled; STOP"27X"")
0423       127 FORMAT (" CALL WRITF (IDCB,IERR,CNTRL,"I3","I2","I2")  fa
0424          *iled; STOP"26X"")
0425       128 FORMAT (" CALL READF (IDCB,IERR,A,"I3","I2","I2")  failed
0426          *; STOP"27X"")
0427       129 FORMAT (" CALL WRITF (IDCB,IERR,A,"I3","I2","I2")  failed
0428          *; STOP"26X"")
0429       130 FORMAT (" CALL CLOSE (IDCB,IERR,0)  failed; STOP"40X""
0430          *)
0431           LI = LOGLU(ISESSN)
0432           ISECU = 0
0433           ICR = 26
0434           IF ( IWHATA  .LT.  1   .OR.   IWHATA  .GT.  2 ) GO TO 40
0435           GO TO (10,20) IWHATA
0436
0437
0438
0439    C     .....................................................................
0440    C     .                                                                   .
0441    C     .  Integer array IBUF being written back and forth.                 .
0442    C     .                                                                   .
0443    C     .....................................................................
0444       10 CALL CODE
0445           WRITE (IFILE,108)
0446           CALL OPEN  (IDCB,IERR,IFILE,IOPTN,ISECU,ICR,IDCBS)
0447           IF ( IERR  .GE.  0 ) GO TO 11
0448           WRITE (LI, 121) IFILE,IOPTN,ISECU,ICR,IDCBS
0449           STOP 1
0450       11 CALL LOCF  (IDCB,IERR,IDUM,IDUM,IDUM,ISIZE(1),IDUM,IDUM,ISIZE(2))
```

```
0451          IF ( IERR  .GE.  0 ) GO TO 12
0452          WRITE (LI, 122)
0453          STOP 2
0454       12 CALL RWNDF (IDCB,IERR)
0455          IF ( IERR  .GE.  0 ) GO TO 13
0456          WRITE (LI, 123)
0457          STOP 3
0458       13 ISIZE(1) = ISIZE(1)/2
0459          IL          = ISIZE(1)*ISIZE(2)
0460          IF ( IREWR  .EQ.  -1 ) GO TO 14
0461          IF ( IREWR  .EQ.  +1 ) GO TO 15
0462       14 CALL READF (IDCB,IERR,IBUF,IL)
0463          IF ( IERR  .GE.  0 ) WRITE (LI, 102)
0464          IF ( IERR  .GE.  0 ) GO TO 16
0465          WRITE (LI, 124) IL,LEN,NUM
0466          STOP 4
0467       15 CALL WRITF (IDCB,IERR,IBUF,IL)
0468          IF ( IERR  .GE.  0 ) WRITE (LI, 101)
0469          IF ( IERR  .GE.  0 ) GO TO 16
0470          WRITE (LI, 125) IL,LEN,NUM
0471          STOP 5
0472       16 CALL CLOSE (IDCB,IERR,0)
0473          IF ( IERR  .GE.  0 ) GO TO 17
0474          WRITE (LI, 130)
0475          STOP 6
0476       17 RETURN
0477
0478
0479
0480    C     .....................................................................
0481    C     .                                                                   .
0482    C     .  Integer array CNTRL being written back and forth.                .
0483    C     .                                                                   .
0484    C     .....................................................................
0485       20 CALL CODE
0486          WRITE (IFILE,109)
0487          CALL OPEN  (IDCB,IERR,IFILE,IOPTN,ISECU,ICR,IDCBS)
0488          IF ( IERR  .GE.  0 ) GO TO 21
0489          WRITE (LI, 121) IFILE,IOPTN,ISECU,ICR,IDCBS
0490          STOP 11
0491       21 CALL LOCF  (IDCB,IERR,IDUM,IDUM,IDUM,ISIZE(1),IDUM,IDUM,ISIZE(2))
0492          IF ( IERR  .GE.  0 ) GO TO 22
0493          WRITE (LI, 122)
0494          STOP 12
0495       22 CALL RWNDF (IDCB,IERR)
0496          IF ( IERR  .GE.  0 ) GO TO 23
0497          WRITE (LI, 123)
0498          STOP 13
0499       23 ISIZE(1) = ISIZE(1)/2
0500          IL          = ISIZE(1)*ISIZE(2)
0501          IF ( IREWR  .EQ.  -1 ) GO TO 24
0502          IF ( IREWR  .EQ.  +1 ) GO TO 25
0503       24 CALL READF (IDCB,IERR,CNTRL,IL)
0504          IF ( IERR  .GE.  0 ) WRITE (LI, 104)
0505          IF ( IERR  .GE.  0 ) GO TO 26
0506          WRITE (LI, 126) IL,LEN,NUM
0507          STOP 14
0508       25 CALL WRITF (IDCB,IERR,CNTRL,IL)
0509          IF ( IERR  .GE.  0 ) WRITE (LI, 103)
0510          IF ( IERR  .GE.  0 ) GO TO 26
0511          WRITE (LI, 127) IL,LEN,NUM
0512          STOP 15
0513       26 CALL CLOSE (IDCB,IERR,0)
0514          IF ( IERR  .GE.  0 ) GO TO 27
0515          WRITE (LI, 130)
0516          STOP 16
0517       27 RETURN
0518
0519
0520
0521    C     .....................................................................
0522    C     .                                                                   .
0523    C     .  Real array A being written back and forth.                       .
0524    C     .                                                                   .
0525    C     .....................................................................
0526    C  30 CALL CODE
```

```
0527   C      WRITE (IFILE,110)
0528   C      CALL OPEN  (IDCB,IERR,IFILE,IOPTN,ISECU,ICR,IDCBS)
0529   C      IF ( IERR  .GE.  0 ) GO TO 31
0530   C      WRITE (LI, 121) IFILE,IOPTN,ISECU,ICR,IDCBS
0531   C      STOP 21
0532   C   31 CALL LOCF  (IDCB,IERR,IDUM,IDUM,IDUM,ISIZE(1),IDUM,IDUM,ISIZE(2))
0533   C      IF ( IERR  .GE.  0 ) GO TO 32
0534   C      WRITE (LI, 122)
0535   C      STOP 22
0536   C   32 CALL RWNDF (IDCB,IERR)
0537   C      IF ( IERR  .GE.  0 ) GO TO 33
0538   C      WRITE (LI, 123)
0539   C      STOP 23
0540   C   33 ISIZE(1) = ISIZE(1)/2
0541   C      IL        = ISIZE(1)*ISIZE(2)
0542   C      IF ( IREWR  .EQ.  -1 ) GO TO 34
0543   C      IF ( IREWR  .EQ.  +1 ) GO TO 35
0544   C   34 CALL READF (IDCB,IERR,A,IL)
0545   C      IF ( IERR  .GE.  0 ) WRITE (LI, 106)
0546   C      IF ( IERR  .GE.  0 ) GO TO 36
0547   C      WRITE (LI, 128) IL,LEN,NUM
0548   C      STOP 24
0549   C   35 CALL WRITF (IDCB,IERR,A,IL)
0550   C      IF ( IERR  .GE.  0 ) WRITE (LI, 105)
0551   C      IF ( IERR  .GE.  0 ) GO TO 36
0552   C      WRITE (LI, 129) IL,LEN,NUM
0553   C      STOP 25
0554   C   36 CALL CLOSE (IDCB,IERR,0)
0555   C      IF ( IERR  .GE.  0 ) GO TO 37
0556   C      WRITE (LI, 130)
0557   C      STOP 26
0558   C   37 RETURN
0559
0560
0561
0562   C      .....................................................................
0563   C      .                                                                   .
0564   C      .  Error;  IWHATA is not defined.                                   .
0565   C      .                                                                   .
0566   C      .....................................................................
0567        40 WRITE (LI, 107) IWHATA
0568           IWHATA = -IWHATA
0569           RETURN
0570           END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 01148 COMMON = 00000

```
0571          SUBROUTINE RPACE (ADCHNL,PAMO,PAIR,START,INCR,STOP,REP,AVRGE,IPRIN
0572         *T,LO)
0573    C     .....................................................................
0574    C     .                                                                   .
0575    C     .  Interface program to trigger HP A/D converted through pacer.     .
0576    C     .  Author:     Hans M. Zebner                                       .
0577    C     .  Date:       March 20, 1980                                       .
0578    C     .  Detailed program description is available in TXCO log.           .
0579    C     .                                                                   .
0580    C     .....................................................................
0581         *, Triggers A/D through Pacer.                "
0582
0583          COMMON / CIBUF / BUFR
0584          COMMON / CONTR / CNTRL
0585
0586          INTEGER BUFR(1664),CNTRL(256)
0587          INTEGER ADCHNL,PAMO,PAIR,START,INCR,STOP,REP,NOLF,ICLR(3),WHERE,WH
0588         *EREP
0589
0590          DATA NOLF /006537B/
0591          DATA ICLR /015524B,015515B,006537B/
0592          DATA MASK /177700B/
0593          DATA FSVLTG /.1E01/
0594
0595    C     FORMATS RPACE START
0596      101 FORMAT (/ 9X" ENTERED SUBROUTINE RPACE ("I2","I1","I2","I6","I2","
0597         *I6","I2",AVRGE,"I1","I2")")
0598      102 FORMAT (10X"AVRGE"3X"ICOUNT"3X"IBLAD"1X"REP"5X"IBUF"4X"IBUF"5X"RBU
0599         *F"1X"BUFR(ICOUNT)")
0600      103 FORMAT ("Pointer at       "63X"A2)
0601      104 FORMAT ((" "A2))
0602      105 FORMAT (20X,I4,1X,K7,2X,K2,1X,K8,I8,1X,F8.6,1X,I12,A2)
0603      106 FORMAT (1X,F14.1,5X,I4,1X,K7,I4,1X,K8,I8,1X,F8.6,1X,I12)
0604      107 FORMAT ( 7X" COMPLETED SUBROUTINE RPACE ("I2","I1","I2","I6","I2",
0605         *"I6","I2","F5.3","I1","I2")")
0606      108 FORMAT ("Done"10X"

0608      149 FORMAT ((3A2))
0609    C     FORMATS RPACE STOP
0610
0611
0612
0613    C     .....................................................................
0614    C     .                                                                   .
0615    C     .  Check the input variables.  If one is out of range, it is        .
0616    C     .  set to the default value.  No warning is displayed.              .
0617    C     .                                                                   .
0618    C     .....................................................................
0619          LI = CNTRL(19)
0620          IF ( IPRINT  .EQ.   0 ) GO TO 01
0621          LINES = 0
0622          WRITE (LI, 101) ADCHNL,PAMO,PAIR,START,INCR,STOP,REP,IPRINT,LO
0623          WRITE (LI, 102)
0624          IF ( LO      .EQ.  LI ) GO TO 01
0625          WRITE (LO, 101) ADCHNL,PAMO,PAIR,START,INCR,STOP,REP,IPRINT,LO
0626          WRITE (LO, 102)
0627       01 IF ( ADCHNL  .GT.   15   .OR.   ADCHNL  .LT.    0 ) ADCHNL =   0
0628          IF ( PAMO    .GT.    2   .OR.   PAMO    .LT.    0 ) PAMO   =   1
0629          IF ( PAIR    .GT.    9   .OR.   PAIR    .LT.    2 ) PAIR   =   1
0630          IF ( START   .LT.    0                             ) START  =   0
0631          IF ( INCR    .LT.    1                             ) INCR   =   1
0632          IF ( REP     .LT.    1                             ) REP    =   1
0633    C     .....................................................................
0634    C     .                                                                   .
0635    C     .  Check input variables for logical errors.                        .
0636    C     .                                                                   .
0637    C     .....................................................................
0638          IF ( STOP    .LE.  START      ) STOP = START+1
0639          IF ( INCR    .GT.  STOP-START ) INCR = STOP-START
0640
0641
0642
0643    C     .....................................................................
0644    C     .                                                                   .
0645    C     .  Get adjusted START and STOP, depending on selected PAMO.         .
0646    C     .                                                                   .
```

```
0647  C     .....................................................................
0648        GO TO (03,02) PAMO
0649     02 START = (START + 256*PAIR) + 100000B
0650        STOP  = (STOP  + 256*PAIR) + 100000B
0651     03 IF ( IPRINT  .NE.  0 ) GO TO 05
0652        ICOUNT = 0
0653        DO 04 I=START,STOP,INCR
0654     04 ICOUNT = ICOUNT+1
0655        IDIFF  = ICOUNT
0656        ICORR  = 1
0657        IF ( IDIFF  .GT.  64 ) GO TO 05
0658        ICORR  = (64/IDIFF)
0659     05 ICOUNT = 0
0660
0661
0662
0663  C     .....................................................................
0664  C     .                                                                   .
0665  C     .  Start acquisition loop.                                          .
0666  C     .                                                                   .
0667  C     .....................................................................
0668        AVRGE = 0
0669        WHEREP = 1
0670        IF ( IPRINT  .EQ.  0 ) WRITE (LI, 103) NOLF
0671        DO 10 I=START,STOP,INCR
0672        ICOUNT = ICOUNT + 1
0673        WHERE = (ICOUNT*64)/IDIFF
0674        IF ( WHERE  .GT.  WHEREP  .AND.  IPRINT  .EQ. 0 ) GO TO 06
0675        GO TO 07
0676     06 WHEREP = WHERE
0677        WRITE (LI, 104) (NOLF,K=1,ICORR)
0678     07 CONTINUE
0679
0680
0681
0682  C     .....................................................................
0683  C     .                                                                   .
0684  C     .  Repeat A/D conversion at selected point REP times.               .
0685  C     .                                                                   .
0686  C     .....................................................................
0687        RBUF = 0
0688        BUFR(ICOUNT) = 0
0689        DO 08 J=1,REP,1
0690        CALL EXEC (3,19)
0691        CALL EXEC (1,19,IRPM,1,I)
0692        CALL EXEC (1,20,IBUF,1,ADCHNL,0)
0693        IBUF = IAND(IBUF,MASK)
0694        RBUF = FLOAT(IBUF)/32768. + RBUF
0695        IF ( IPRINT  .EQ.  0                              ) GO TO 08
0696        WRITE (LI, 105) ICOUNT,I,J,IBUF,IBUF,RBUF,BUFR(ICOUNT),NOLF
0697        IF ( LO      .EQ.  LI   .OR.  LO  .EQ.  6 ) GO TO 08
0698        WRITE (LO, 105) ICOUNT,I,J,IBUF,IBUF,RBUF,BUFR(ICOUNT),NOLF
0699     08 CONTINUE
0700        BUFR(ICOUNT) = ((RBUF*FSVLTG)/REP)*10000
0701
0702
0703
0704        AVRGE = AVRGE + BUFR(ICOUNT)
0705        IF ( IPRINT  .EQ.  0 ) GO TO 10
0706        WRITE (LI, 106) AVRGE,ICOUNT,I,REP,IBUF,IBUF,RBUF,BUFR(ICOUNT)
0707        LINES = LINES+1
0708        IF ( LINES   .LT.  20 ) GO TO 09
0709        WRITE (LI, 149) (ICLR,K=1,LINES)
0710        LINES = 0
0711     09 IF ( LO      .EQ.  LI ) GO TO 10
0712        WRITE (LO, 106) AVRGE,ICOUNT,I,REP,IBUF,IBUF,RBUF,BUFR(ICOUNT)
0713     10 CONTINUE
0714  C     .....................................................................
0715  C     .                                                                   .
0716  C     .  Stop data acquisition loop.                                      .
0717  C     .                                                                   .
0718  C     .....................................................................
0719
0720
0721
0722        AVRGE = (AVRGE/ICOUNT)/10000
```

```
0723          IF ( IPRINT  .EQ.   0 ) GO TO 11
0724          LINES = LINES+1
0725          WRITE (LI, 149) (ICLR,I=1,LINES)
0726          WRITE (LI, 107) ADCHNL,PAMO,PAIR,START,INCR,STOP,REP,AVRGE,IPRINT,
0727         *LO
0728          IF ( LO      .EQ.  LI ) GO TO 11
0729          WRITE (LO, 107) ADCHNL,PAMO,PAIR,START,INCR,STOP,REP,AVRGE,IPRINT,
0730         *LO
0731
0732
0733
0734       11 CONTINUE
0735          IF ( IPRINT  .NE.   0 ) GO TO 12
0736          WRITE (LI, 108)
0737          WRITE (LI, 149) ICLR
0738       12 RETURN
0739          END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 00973 COMMON = 00000

```
0740          REAL FUNCTION SCANR (LU,ICHAN,K)
0741    C     ..................................................................
0742    C     .                                                                .
0743    C     .  Close relay ICHAN on scanner LU and read the instrument       .
0744    C     .  indicated by K.                                               .
0745    C     .  Author:     Robert N. Geopfarth                               .
0746    C     .  Date:       February 31, 1979                                 .
0747    C     .  Detailed program description is available in TXCO log;  the   .
0748    C     .  variables are:                                                .
0749    C     .  LU       ...   LU# of desired scanner (8 or 15).              .
0750    C     .  ICHAN    ...   Scanner channel (integer).                     .
0751    C     .  IC       ...   Scanner channel (ASCII).                       .
0752    C     .  K        ...   Instrument code ( DVM = 1 / Counter = 2 ).     .
0753    C     .                                                                .
0754    C     ..................................................................
0755          *, Closes scanner and reads DVM, counter.  "
0756       101 FORMAT (A2)
0757       801 FORMAT ("C")
0758      1001 FORMAT ("T3T3")
0759      1201 FORMAT ("T")
0760      1501 FORMAT ("C")
0761
0762           WRITE ( 8, 801)
0763           WRITE (15,1501)
0764           IC = ICON(ICHAN,0)
0765           WRITE (LU, 101) IC
0766           GO TO (01,02) K
0767
0768        01 CALL TRIGR (10)
0769           READ  (10,   *) DUM
0770           CALL TRIGR (10)
0771           READ  (10,   *) SCANR
0772           GO TO 03
0773
0774        02 WRITE (12,1201)
0775           READ  (12,   *) SCANR
0776
0777        03 WRITE (LU, 801)
0778           RETURN
0779           END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 00104 COMMON = 00000

```
0780          SUBROUTINE TIME (IMON,IDAY,IYEAR,IHOUR,IMIN,ISEC)
0781    C     ..................................................................
0782    C     .                                                                .
0783    C     .  Get date and time and convert the variables to ASCII          .
0784    C     .                                                                .
0785    C     ..................................................................
0786         *, Gets date and time   ASCII string.       "
0787          COMMON / CONTR / CNTRL
0788          INTEGER ITIME(5)
0789          INTEGER CNTRL(256)
0790      901 FORMAT (" ERROR DETECTED IN PROGRAM TIME"/
0791         *          " CALL EXEC (11,ITIME)"/)
0792
0793          IMON = 2H$$
0794          IDAY = 2H$$
0795          IYEAR= 2H$$
0796          IHOUR= 2H$$
0797          IMIN = 2H$$
0798          ISEC = 2H$$
0799          CALL EXEC (11+100000B,ITIME)
0800          GO TO 02
0801       01 GO TO 03
0802       02 CALL ABREG (IA,IB)
0803          GO TO 04
0804       03 IMON  = ICON(CNTRL(1),0)
0805          IDAY  = ICON(CNTRL(2),0)
0806          IYEAR = ICON(CNTRL(3),0)
0807          IHOUR = ICON(ITIME(4),0)
0808          IMIN  = ICON(ITIME(3),0)
0809          ISEC  = ICON(ITIME(2),0)
0810          RETURN
0811       04 WRITE ( 6, 901) IA,IB
0812          RETURN
0813          END
```

FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

** NO WARNINGS ** NO ERRORS ** PROGRAM = 00146 COMMON = 00000

```
0814          SUBROUTINE WAIT (TWAIT)
0815    C     ..........................................................
0816    C     .                                                        .
0817    C     .  Cause a defined time delay of TWAIT*10 milliseconds.  .
0818    C     .  Author:     Hans M. Zebner                            .
0819    C     .  Date:       February 13, 1980                         .
0820    C     .  Because of the simplicity of the program the program  .
0821    C     .  description is included in this box.                  .
0822    C     .  TWAIT  ...   Desired time delay is (TWAIT*10) milliseconds.
0823    C     .  TNOW   ...   Present time.                            .
0824    C     .  TM(5)  ...   Input time buffer (required for EXEC call).
0825    C     .  TSTOP  ...   Final time.                              .
0826    C     .                                                        .
0827    C     ..........................................................
0828          *, Causes a defined time delay.          Geopfarth, Zebner
0829          IMPLICIT INTEGER (T)
0830          INTEGER TM(5)
0831
0832       01 CALL EXEC (11,TM)
0833          THOUR = TM(4)
0834          TSTOP = TM(1) + TM(2)*100 + TM(3)*6000 + TWAIT
0835
0836       02 CALL EXEC (11,TM)
0837          TNOW  = TM(1) + TM(2)*100 + TM(3)*6000
0838          IF ( TM(4)   .NE.   THOUR ) GO TO 01
0839          IF ( TNOW    .LT.   TSTOP ) GO TO 02
0840
0841          RETURN
0842          END


  FTN4 COMPILER: HP92060-16092 REV. 1926 (790430)

  **  NO WARNINGS **  NO ERRORS **   PROGRAM = 00087      COMMON = 00000
```

8. DATA REDUCTION PROGRAMS

Three data reduction programs can be initiated from within the TXCO system. They are the following:

(i) Program REDAB (Enter 9)

This program was written to reduce data from the A-B Kulite probe system following the method given in Ref 2, and outputs distributions of velocity magnitude and flow angles.

(ii) Program REDCO (Enter 10)

This program reduces survey data taken with the combination temperature-pneumatic probe and outputs distributions of pressure rise, temperature rise, Mach number, flow angle and losses.

(iii) Program REDST (Enter 11)

This program reduces data taken from fixed instrumentation and outputs the steady-state performance of the compressor.

The above programs are documented separately.

9. CONCLUSIONS AND RECOMMENDATIONS

The large quantity and variety of instrumentation used in the transonic compressor test facility required that data acquisition programs be provided for the different types of data. This was achieved using a particular program structure. Data reduction programs were strictly separated but geared to the acquisition modules through the use of standard data arrays. The data acquisition programs TXCO1, TXCO2 and TXCO3 have been described in detail and the operator commands are explained. The reduction programs are to be documented separately.

The need for easy-to-understand program control leads to a conflict. If interactive messages which explain the program flow and offer menus giving a selection of next logical steps are included, this introduces extended I/O operations and leads to long programs whose speed in execution is slowed considerably by the I/O's. On the other hand the I/O's may be kept to a minimum, which speeds up execution, but this may also lead to communication gaps between the program and the operator. Since the research on the transonic compressor test rig is carried out in large part by visiting researchers and postgraduate students, it was decided to program closer to the first alternative. However, a very useful compromise was achieved through the introduction of the program control array. Should experience in using the TXCO-system show that

the interactive messages, error processing, or the checking for erroneous operator input are too extensive, then the programs should certainly be trimmed.

At the time the programs were written, a graphic software package was not present in the operating system and therefore original plotter software was generated. The switch from "home made" to HP-supported graphics is recommended.

Finally, if the instrumentation system is changed, corresponding changes can be introduced into the appropriate program module, or a new one can be added. Also, the same or a similar program system can easily be adapted for use on any other test rig or calibration apparatus in the laboratory.

APPENDIX A. DATA ACQUISITION WORK SHEETS

A.1. Data Locations

A.2. Steady State Data Array

A.3. Program Control Array (CNTRL)

A.4. Paced Data Array

A.1. DATA LOCATIONS

Work sheet: data locations

port	Scanivalve #1	Scanivalve #2	Scanner #1	Scanner #2	ch
			Advance S/V #1	T1 A/C nozzle	0
1	PA-PA	PA-PA	" " #2	T comb in	1
2	PCAL-PA	PCAL-PA	" " #3	T turb out L	2
3	P1 nozzle-PA	P1 comb pr-PA	" " #4	T turb out R	3
4	P1 noz th-PA	P23 comb pr-PA	" " #5	T1 comb noz D	4
5	P1 noz fl-PA	P4 comb pr-PA	Reset S/V #1	T1 comb noz W	5
6	PBM-PA	PT2-PA	" " #2	T in sig 00	6
7	PT00-PA	PT1-PA	" " #3	T 04	7
8	S1-PA	PA-PA	" " #4	T 24	8
9	S2-PA	K pn-PA	" " #5	T C4	9
10	S3-PA	P alpha-PA	Transducer S/V #1	T cell	10
11	S4-PA	C7-PA	" " #2		11
12	S5-PA	P4-PA	" " #3	ΔT comb L	12
13	S6-PA	P1-PA	" " #4	ΔT turb R	13
14	S7-PA	P3-PA	" " #5	ΔT 04	14
15	S8-PA	A2-PA	RPM 0/0	ΔT 24	15
16	S9-PA	P7-PA	RPM T00	ΔT C4	16
17	S10-PA	C0-PA	RPM 10		17
18	S11-PA	P3-PA	RPM T20	T in ref pr	18
19	S12-PA	M3-PA	Blade pass angle	T comb ref	19
20	S13-PA	P3-PA	ITR pr		20
21	S14-PA	M4-PA	ITR CLAM		21
22	S15-PA	M0-PA	ITR CLAM		22
23	S16-PA	C1-PA	ITR Outlet		23
24	S17-PA	M5-PA	ITR Inlet		24
25	PA-PA	P3-PA	P barometric		25
26	PCAL-PA	C5-PA	P1 nozzle comb		26
27	S19-PA	M6-PA	P nozzle COMB		27
28	S14-PA	M5-PA	P1 nozzle THRO		28
29	H1-PA	P0-PA	P nozzle THRO		29
30	H2-PA	A7-PA	rad inl comb pr		30
31	H3-PA	P burning-PA	duct comb pr		31
32	H4-PA	P thrust-PA	rad inl 90° pr		32
33	H5-PA	PT turb in-PA	duct 45° pr		33
34	H6-PA	P st out L-PA	rad inl 0° pr		34
35	H7-PA	P st out R-PA	duct 180° pr		35
36	H8-PA	PT no out L-PA	Torque TCP		36
37	H9-PA	PT no out R-PA	RPL ref pres		37
38	H10-PA	P no out L-PA			38
39	H11-PA	P no out R-PA			39
40	Diff T1-PA	PA-PA			40
41	Diff T2-PA	P diff L-PA			41
42	Diff T3-PA	P diff 2-PA			42
43	Diff T4-PA	P diff 3-PA			43
44	Diff T5-PA	P diff 4-PA			44
45	Diff T6-PA	P diff 5-PA			45
46	Diff T7-PA				46
47	Diff T8-PA				47
48	Diff T9-PA				48

port	Scanivalve #1	Scanivalve #2	Scanner #1	Scanner #2	ch

continued on next page

ch	Scanner #1	Scanner #2	ch
40		wall KUL K6.	40
41		" " K7.	41
42		" " K8.	42
43		" " K8.5	43
44		" " K9.	44
45		" " K9.5	45
46		" " K10.	46
47		" " K10.5	47
48		" " K11.	48
49		" " K12.	49
50			50
51			51
52		'A' KUL pr	52
53		'B' KUL pr	53
54			54
55			55
56			56
57			57
58			58
59			59
60			60
61			61
62			62
63			63
64			64
65			65
66			66
67			67
68			68
69			69
70			70
71			71
72			72
73			73
74			74
75			75
76			76
77			77
78			78
79			79
ch	Scanner #1	Scanner #2	ch

A.2. STEADY STATE DATA ARRAY

Work sheet to decode the data array for the steady state data

File name convention: raw steady state data T4RRSS
reduced steady state data T9RRSS

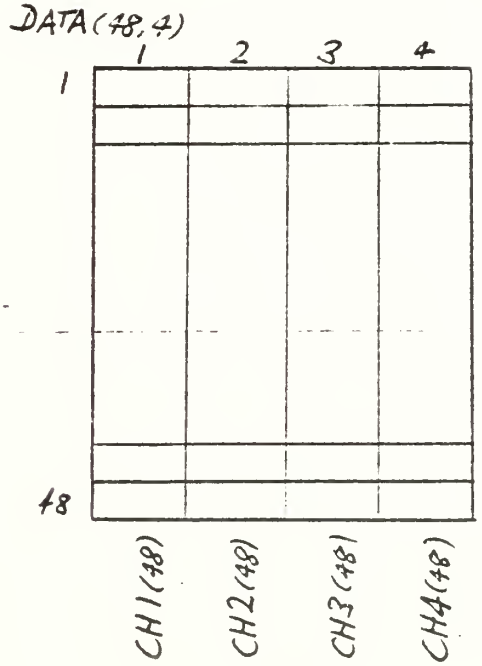
RR = ASCII converted run#
SS = file sequential # from this run

Note : In some cases the letter T (which stands for Transonic compressor) may be changed to any other character in order to prevent overwriting an existing data file.

Example: T40503 is the third data file from test run #5, that contains steady state data. The data reduction program REDST (Reduction steady state data) creates the file T90503 to take the reduced data from this run.

Due to interface bus problems the data acquisition program STDY sometimes has to be aborted, but may already have produced some valid raw data files. When the program is restarted it tries to open to data files, whose names already exist. To avoid purging these files, the operator has interactively change the first character of the data file name to T40503, e.g., The reduced data of course are the in file D90503.

By the way, T40503 contains good data. You will find this file in cartridge 29 and can use it to get acquainted with REDST.



I	CH1(I)	CH2(I)	CH3(I)	CH4(I)	I
1	PA-PA	PA-PA	P barometric	n/a	1
2	PCAL-PA	PCAL-PA	P1 nozzle comor	n/a	2
3	P1 nozzle-PA	P1 comb pr-PA	P nozzle comor	PRTT	3
4	P1 noz th-PA	P35 comb pr-PA	P1 nozzle turb	TT1T	4
5	P1 noz fl-PA	P4 comb pr-PA	P nozzle turb	TT3T	5
6	PBM-PA	PT2-PA	n/a	DTTT	6
7	PT00-PA	PT1-PA	rad pos comb pr	MFLT	7
8	S1-PA	PA-PA	yaw comb pr	HPT	8
9	S2-PA	K eq-PA	rad pos 'A' pr	HPM	9
10	S3-PA	P alpha-PA	yaw 'A' pr	PRCT	10
11	S4-PA	C7-PA	rad pos 'B' pr	TT1C	11
12	S5-PA	A1-PA	yaw 'B' pr	TT3C	12
13	S6-PA	B1-PA	n/a	DTTC	13
14	S7-PA	C1-PA	T1 A/C nozzle	MFLC	14
15	S8-PA	A2-PA	T turb in	HPC	15
16	S9-PA	B2-PA	T turb out L	PRCTR	16
17	S10-PA	C2-PA	T turb out R	RPMCR	17
18	S11-PA	A3-PA	n/a	MFLCR	18
19	S12-PA	B3-PA	T1 comb noz A	TORQCR	19
20	S13-PA	C3-PA	T1 comb noz B	HPMR	20
21	S14-PA	A4-PA	T in stg 00	HPCR	21
22	S15-PA	B4-PA	T out A4	HPTR	22
23	S16-PA	C4-PA	T out B4	EFF0	23
24	S17-PA	A5-PA	T out C4	EFF1	24
25	P0-PA	B5-PA	T cell	EFF2	25
26	PCAL-PA	C5-PA	n/a	EFF3	26
27	S18-PA	A6-PA	ΔT turb L	n/a	27
28	S19-PA	B6-PA	ΔT turb R	n/a	28
29	H1-PA	C6-PA	ΔT A4	n/a	29
30	H2-PA	A7-PA	ΔT B4	T in ref pr	30
31	H3-PA	P bearing-PA	ΔT C4	T comb ref	31
32	H4-PA	P thrust-PA	n/a	n/a	32
33	H5-PA	PT turb in-PA	KUL ref pres	run #	33
34	H6-PA	P st out L-PA	wall KUL K6.	test #	34
35	H7-PA	P st out R-PA	" " K7.	point #	35
36	H8-PA	PT no out L-PA	" " K8.	day	36
37	H9-PA	PT no out R-PA	" " K8.5	month	37
38	H10-PA	P no out L-PA	" " K9.	year	38
39	H11-PA	P no out R-PA	" " K9.5	machine code	39
40	Diff T1-PA	PA-PA	" " K10.	n/a	40
41	Diff T2-PA	P diff 1-PA	" " K10.5	n/a	41
42	Diff T3-PA	P diff 2-PA	" " K11.	n/a	42
43	Diff T4-PA	P diff 3-PA	" " K12.	case angle	43
44	Diff T5-PA	P diff 4-PA	" " K13.	n/a	44
45	Diff T6-PA	P diff 5-PA	" " K14.	n/a	45
46	Diff T7-PA	n/a	n/a	RPM	46
47	Diff T8-PA	n/a	'A' KUL pr	Torque	47
48	Diff T9-PA	n/a	'B' KUL pr	n/a	48
I	CH1(I)	CH2(I)	CH3(I)	CH4(I)	I

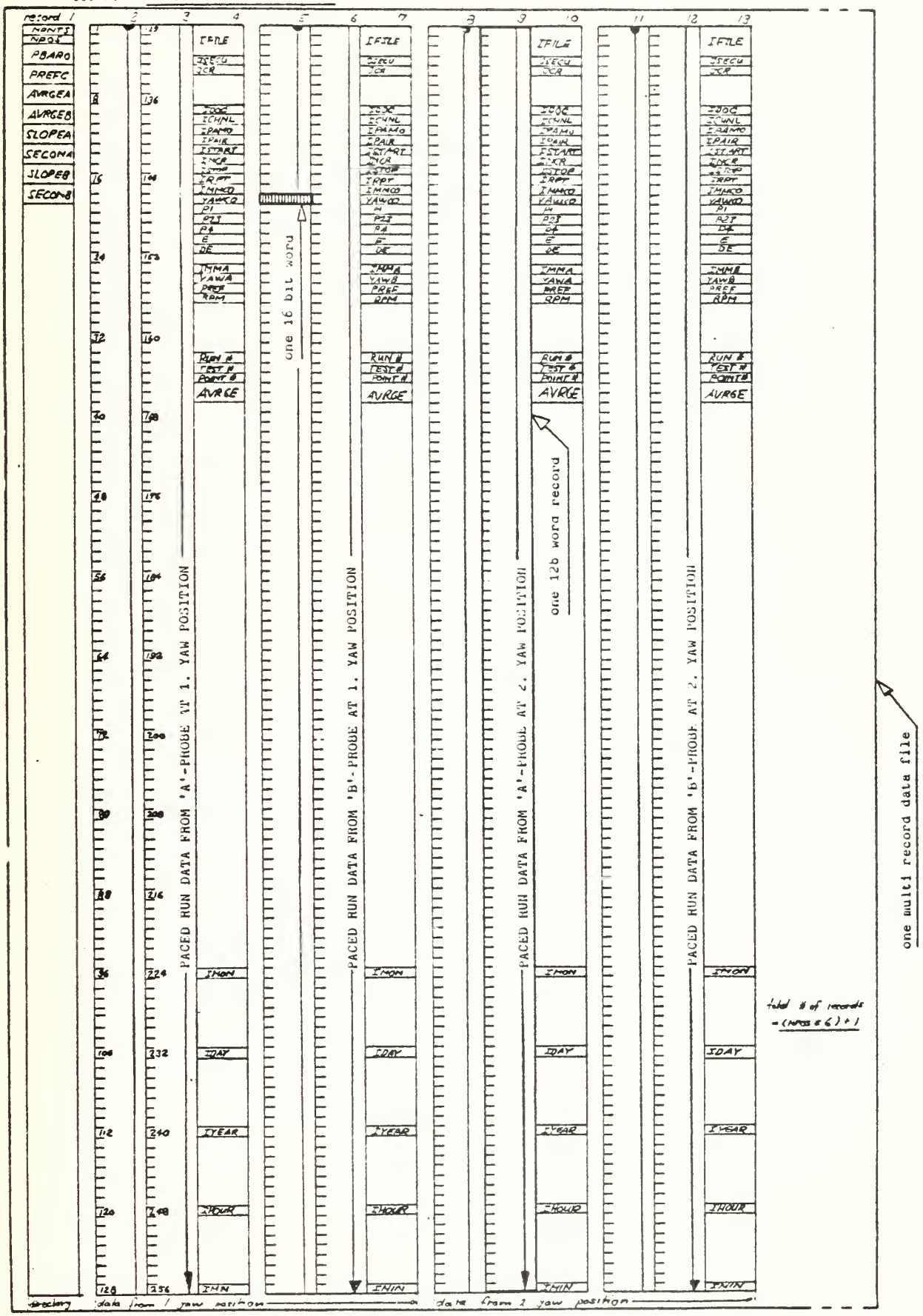
A.3. PROGRAM CONTROL ARRAY (CNTRL)

Work sheet to decode/encode the control array CNTRL:

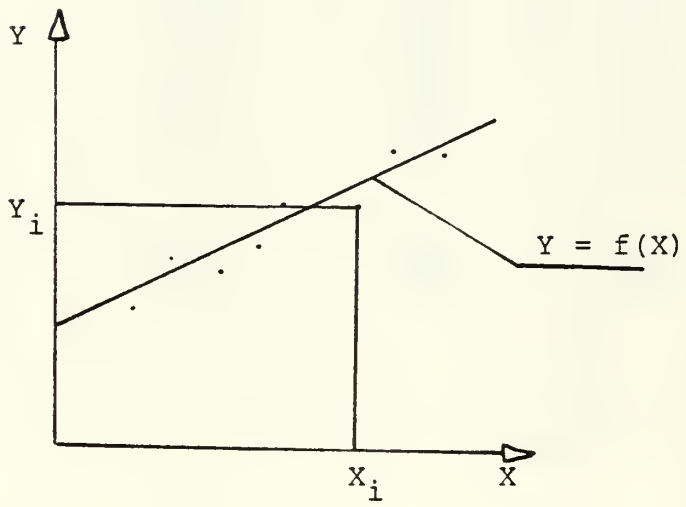
CNTRL(1)	:	Month of the test run.
CNTRL(2)	:	Day " " " " .
CNTRL(3)	:	Year " " " " .
CNTRL(4)	:	Test run #.
CNTRL(5)	:	Test # of this run
CNTRL(6)	:	Point # of this test.
CNTRL(15)	:	Machine Code.
CNTRL(19)	:	LU# of the standard interactive input device.
CNTRL(20)	:	LU# " " " output device .
CNTRL(21)	:	LU# " " optional output device .
CNTRL(22)	:	LU# " " plotter.
CNTRL(30)	:	Cartridge reference # for data files.
CNTRL(31)	:	Security code for data files.
CNTRL(32)	:	First and second character of data file name: FILE(1)
CNTRL(33)	:	Third and fourth " " " " " " : FILE(2)
CNTRL(34)	:	Fifth and sixth " " " " " " : FILE(3)
CNTRL(36)	:	Initializes for steady state data reduction run, if set to 1.
CNTRL(37)	:	Suppresses printing of heading in subroutines FREER and PACER, if set to 1.
CNTRL(39)	:	Suppresses creation/opening and closing of files in subroutines FREER and PACER, if set to 1.
CNTRL(40)	:	Suppresses analog output of just acquired paced run data to terminal if set to 1.
CNTRL(41)	:	100*Factor to vary size in x-direction of a drawing.
CNTRL(42)	:	100*Factor to vary size in y-direction of a drawing.
CNTRL(50)	:	Indicates the son program to be scheduled and the subroutine to be called there from. 01 ... Schedule TXC01 and call ARSRV 02 ... " " " " CALIB 03 ... " " " " FREER 04 ... " " " " PACER 05 ... Schedule TXC02 and call COMB 06 ... " " " " STDY 07 ... Schedule TXC03 and call CHECK 08 ... " " " " CHNGE 09 ... Schedule REDAR 10 ... Schedule REDCO 11 ... Schedule REDST.
CNTRL(61)	:	Number of S/V controller #I.
CNTRL(62)	:	" " " " #II.
CNTRL(63)	:	" " " " #III.
CNTRL(64)	:	" " " " #IV.
CNTRL(65)	:	" " " " #V.
CNTRL(71)	:	LU# of scanner #1.
CNTRL(72)	:	LU# " " #2.
CNTRL(212)	:	Accounting variable subroutine ARSRV: output page #.
CNTRL(213)	:	" " " ARSRV: current file #.
CNTRL(214)	:	" " " CALIB: output page #.
CNTRL(215)	:	" " " CALIB: current file #.
CNTRL(216)	:	" " " FREER: output page #.
CNTRL(217)	:	" " " FREER: current file #.

CNTRL(218)	:	" " " PACER: output page #.
CNTRL(219)	:	" " " PACER: current file #
CNTRL(221)	:	Blade pair (1 - 9), if Pacer is operated in mode 2.
CNTRL(222)	:	Start count for data acquisition using Pacer encode.
CNTRL(223)	:	Increment " " " " " " " "
CNTRL(224)	:	Stop count " " " " " " " "
CNTRL(225)	:	# of repetitions at each location in blade passage.
CNTRL(230)	:	Total # of high speed data acquisitions either in free or in paced run mode to be taken.
CNTRL(231)	:	A/D input channel for KULITE type 'A' probe.
CNTRL(232)	:	" " " " " " " 'B' "
CNTRL(235)	:	" " " wall KULITE #6.
CNTRL(236)	:	" " " " " K7.
CNTRL(237)	:	" " " " " K8.
CNTRL(238)	:	" " " " " K8.5.
CNTRL(239)	:	" " " " " K9.
CNTRL(240)	:	" " " " " K9.5.
CNTRL(241)	:	" " " " " K10.
CNTRL(242)	:	" " " " " K10.5.
CNTRL(243)	:	" " " " " K11.
CNTRL(244)	:	" " " " " K12.
CNTRL(245)	:	" " " " " K13.
CNTRL(246)	:	" " " " " K14.
CNTRL(249)	:	Character used for analog display in subroutine PICTR.
CNTRL(250)	:	# of multiples of 10ms for S/V controller time delay.
CNTRL(251)	:	Total # of free run measurements (max. 1664).

A.4. PACED DATA ARRAY



APPENDIX B. LINEAR APPROXIMATION BY METHOD OF LEAST SQUARES



Data: X_i and Y_i ; i = 1,...,NPNTSI

Equation: $Y = C_1 + C_2 \cdot X$

Difference for Each Data Point: $R_i = Y_i - f(X_i)$; i=1,...,NPNTSI

Sum of Squares of Differences: $$R = \sum_{i=1}^{NPNTSI} R_i^2 = \left[\sum_{i=1}^{NPNTSI} Y_i - (C_1+C_2 \cdot X_i)\right]^2$$

The value of R depends on the values of the coefficients C_1 and C_2. In order to determine a minimum value for R, the expression for R is partially differentiated with respect to C_1 and C_2 and the two derivatives are equated to zero. Differentiating,

$$\frac{\partial R}{\partial C_1} = \sum_{i=1}^{NPNTSI} 2 \cdot \left[Y_i - (C_1 + C_2 \cdot X_i)\right] \cdot (-1)$$

and

$$\frac{\partial R}{\partial C_2} = \sum_{i=1}^{NPNTSI} 2 \cdot \left[Y_i - (C_1 + C_2 \cdot X_i) \right] \cdot (-X_i)$$

Setting each expression to zero,

$$\sum_{i=1}^{NPNTSI} (Y_i - C_1 - C_2 \cdot X_i) = 0$$

$$\sum_{i=1}^{NPNTSI} (Y_i \cdot X_i - C_1 \cdot X_i - C_2 \cdot X_i^2) = 0$$

This gives two equations in which C_1 and C_2 are the only unknowns. Omitting the limits of summation for simplicity,

$$\sum C_1 + \sum C_2 X_i = \sum Y_i$$

$$\sum C_1 X_i + \sum C_2 X_i^2 = \sum Y_i \cdot X_i$$

or, in matrix notation (note that C_1 and C_2 are constants)

$$\begin{vmatrix} NPNTSI & \sum X_i \\ \sum X_i & \sum X_i^2 \end{vmatrix} \cdot \begin{vmatrix} C_1 \\ C_2 \end{vmatrix} = \begin{vmatrix} \sum Y_i \\ \sum Y_i X_i \end{vmatrix}$$

or

$$A \cdot C = B$$

The components of the matrix C are obtained using

$$a_{11} = NPNTSI$$

$$a_{12} = a_{21} = \sum X_i$$

$$a_{22} = \sum X_i^2$$

$$b_1 = \sum Y_i$$

$$b_2 = \sum Y_i \cdot X_i$$

$$C_1 = \frac{\begin{vmatrix} b_1 & a_{12} \\ b_2 & a_{22} \end{vmatrix}}{\begin{vmatrix} a_{11} & a_{12} \\ a_{12} & a_{22} \end{vmatrix}} = \frac{a_{22}b_1 - a_{12}b_2}{a_{11}a_{22} - a_{12}^2}$$

$$C_2 = \frac{a_{11}b_2 - a_{12}b_1}{a_{11}a_{22} - a_{12}^2}$$

$$C_1 = \frac{\sum X_i^2 \cdot \sum Y_i - \sum X_i \cdot \sum (Y_i\ X_i)}{NPNTSI \cdot \sum X_i^2 - (\sum X_i)^2}$$

$$C_2 = \frac{NPNTSI \cdot \sum (Y_i \cdot X_i) - \sum X_i \cdot \sum Y_i}{NPNTSI \cdot \sum X_i^2 - (\sum X_i)^2}$$

REFERENCES

1. Shreeve, R.P., Simmons, J.M., Winters, K.A. and West, J.C. Jr., "Determination of Transonic Compressor Flow Field by Synchronized Sampling of Stationary Fast Response Transducers", Symposium on Non-Steady Fluid Dynamics, ASME 1978 Winter Annual Meeting, San Francisco, Ca., Dec. 1978.

2. Shreeve, R.P., McGuire, A.G. and Hammer, J.A., "Calibration of a Two Probe Synchronized Sampling Technique for Measuring Flows Behind Rotors", ICIASF '79 Record, IEEE Cat. No. 79CH1500-8AES, Proceedings of the International Congress on Instrumentation in Aerospace Simulation Facilities held at Monterey, Ca., Sept. 24th - 26th, 1979.

3. McCarville, P.A., "Hardware and Software Improvements to a Paced Data Acquisition System for Turbomachines", Naval Postgraduate School Master's Thesis, June 1981.

4. Adler, D. and Taylor, P.M., "A Procedure for Obtaining Velocity Vector from Two High Response Impact Pressure Probes", Naval Postgraduate School Technical Report NPS67-80-007, August 1980.

5. Shreeve, R.P., "Calibration of Flow Nozzles Using Traversing Pitot-Static Probes", Naval Postgraduate School, Department of Aeronautics, NPS-57Sf3071A, Monterey, Ca., July 1973.

6. Shreeve, R.P., "Report on the Testing of a Hybrid (Radial to Axial) Compressor," Naval Postgraduate School, Department of Aeronautics, NPS-57Sf3112A, Monterey, Ca., November 1973.

7. Sharma, S., "Transonic Compressor Steady State Data Reduction", Naval Postgraduate School, Turbopropulsion Laboratory, Technical Note 79-03, Monterey, Ca., September 1979.

DISTRIBUTION LIST

		No. of Copies
1.	Library Code 0212 Naval Postgraduate School Monterey, California 93940	4
2.	Office of Research Administration Code 012A Naval Postgraduate School Monterey, California 93940	1
3.	Chairman Code 67 Department of Aeronautics Naval Postgraduate School Monterey, California 93940	1
4.	Director, Turbopropulsion Laboratory Department of Aeronautics Naval Postgraduate School Monterey, California 93940	30
5.	Dr. Gerhard Heiche Naval Air Systems Command Code AIR-310 Navy Department Washington, D.C. 20360	1
6.	Mr. Karl H. Guttmann Naval Air Systems Command Code AIR-330 Navy Department Washington, D.C. 20360	1
7.	Dr. A. D. Wood Office of Naval Research 800 North Quincy Street Arlington, Virginia 22217	1
8.	Commanding Officer Naval Air Propulsion Test Center Attn: Mr. Vernon Lubosky Trenton, New Jersey 08628	1

9. National Aeronautics & Space Administration 1
Lewis Research Center (Library)
2100 Brookpark Road
Cleveland, Ohio 44135

10. CAG Library 1
The Boeing Company
Seattle, Washington 98124

11. Library 1
General Electric Company
Aircraft Engine Technology Division
DTO Mail Drop H43
Cincinnati, Ohio 45215

12. Library 1
Pratt and Whitney Aircraft
Post Office Box 2691
West Palm Beach, Florida 33402

13. Library 1
Pratt and Whitney Aircraft
East Hartford, Connecticut 06108

14. Chief, Fan and Compressor Branch 1
Mail Stop 5-9
NASA Lewis Research Center
2100 Brookpark Road
Cleveland, Ohio 44135

15. Prof. D. Adler 1
Technion Israel Institute of Technology
Department of Mechanical Engineering
Haifa 32000
ISRAEL

16. Director, Whittle Laboratory 1
Department of Engineering
Cambridge University
ENGLAND

17. Prof. F. A. E. Breugelmans 1
Institut von Karman de la Dynamique
des Fluides
72 Chausee de Waterloo
1640 Rhode-St. Genese
BELGIUM

18. Library 1
Air Research Mfg. Corporation
Division of Garrett Corporation
402 South 36th Street
Phoenix, Arizona 85034

19. Prof. Jacques Chauvin 1
Universite D'Aix-Marseille
1 Rue Honnorat
Marseille, FRANCE

20. Mr. James V. Davis 1
Teledyne CAE
1330 Laskey Road
Toledo, Ohio 43601

21. Dr. Robert P. Dring 1
United Technologies Research Labs
400 Main Street
Hartford, Connecticut 06108

22. Mr. Jean Fabri 1
ONERA
29, Ave. de la Division Leclerc
92 Chatillon
FRANCE

23. Prof. Dr. Ing Heinz E. Gallus 1
Lehrstuhl und Institut fur Strahlantiebe
und Turbourbeitsmashinen
Rhein.-Westf. Techn. Hochschule Aachen
Templergraben 55
5100 Aachen, WEST GERMANY

24. Professor J. P. Gostelow 1
School of Mechanical Engineering
The New South Wales Institute of Technology
AUSTRALIA

25. Dr. Ing. Hans-J. Heinemann 1
DFVLR-AVA
Bunsenstrasse 10
3400 Gottingen, WEST GERMANY

26. Professor Ch. Hirsch 1
Vrije Universiteit Brussel
Pleinlaan 2
1050 Brussels, BELGIUM

27. Chairman 1
Aeronautics and Astronautics Department
31-265 Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

28. Dr. B. Lakshminarayana 1
Professor of Aerospace Engineering
The Pennsylvania State University
233 Hammond Building
University Park, Pennsylvania 16802

29. Mr. R. A. Langworthy — 1
Army Aviation Material Laboratories
Department of the Army
Fort Eustis, Virginia 23604

30. Prof. Dr. L. G. Napolitano — 1
Director, Institute of Aerodynamics
University of Naples
Viale C. Augusto
80125 Napoli
ITALY

31. Prof. Erik Nilsson — 1
Institutionen for Stromningsmaskinteknik
Chalmers Tekniska Hogskola
Fack, 402 20 Goteborg 5
SWEDEN

32. Prof. Gordon C. Oates — 1
Department of Aeronautics and Astronautics
University of Washington
Seattle, Washington 98105

33. Prof. Walter F. O'Brian — 1
Mechanical Engineering Department
Virginia Polytechnic Institute and
State University
Blacksburg, Virginia 24061

34. Dr. P. A. Paranjee — 1
Head, Propulsion Division
National Aeronautics Laboratory
Post Bag 1799
Bangalore - 17, INDIA

35. R. E. Peacock, Code 67Pc — 1
Department of Aeronautics
Naval Postgraduate School
Monterey, California 93940

36. Dr. W. Schlachter — 1
Brown, Boveri-Sulzer Turbomachinery Ltd.
Dept. TDE
Escher Wyss Platz
CH-8023 Zurich, SWITZERLAND

37. Prof. T. H. Okiishi — 1
Professor of Mechanical Engineering
208 Mechanical Engineering Building
Iowa State University
Ames, Iowa 50011

38. Dr. Fernando Sisto — 1
Professor and Head of Mechanical
Engineering Department
Stevens Institute of Technology
Castle Point, Hoboken, New Jersey 07030

39. Dr. Leroy H. Smith, Jr. — 1
Manager, Compressor and Fan
Technology Operation
General Electric Company
Aircraft Engine Technology Division
DTO Mail Drop H43
Cincinnati, Ohio 45215

40. Dr. W. Tabakoff — 1
Professor, Department of Aerospace
Engineering
University of Cincinnati
Cincinnati, Ohio 45221

41. Mr. P. Tramm — 1
Manager, Research Labs
Detroit Diesel Allison Division
General Motors
P.O. Box 894
Indianapolis, Indiana 46206

42. Prof. Dr. W. Traupel — 1
Institut fur Thermische Turbomaschinen
Eidg. Technische Hochschule
Sonneggstrasse 3
8006 Zurich, SWITZERLAND

43. Dr. Arthur J. Wennerstrom — 1
ARL/LF
Wright-Patterson AFB
Dayton, Ohio 45433

44. Dr. H. Weyer — 1
DFVLR
Linder Hohe
505 Porz-Wahn
WEST GERMANY

45. Mr. P. F. Yaggy — 1
Director
U.S. Army Aeronautical Research Laboratory
AMES Research Center
Moffett Field, California 94035

46. Prof. C. H. Wu — 1
P.O. Box 2706
Beijing 100080
CHINA

47. Director — 1
Gas Turbine Establishment
P.O. Box 305
Jiangyou County
Sichuan Province
CHINA

48. Professor Leonhard Fottner — 1
Department of Aeronautics and Astronautics
German Armed Forces University
Hochschule des Bundeswehr
Werner Heisenbergweg 39
8014 Neubiberg near Munich
WEST GERMANY

49. BDM Corporation — 5
P.O. Box 2019
Monterey, Calaifornia 93940

DUDLEY KNOX LIBRARY
3 2768 00347370 3